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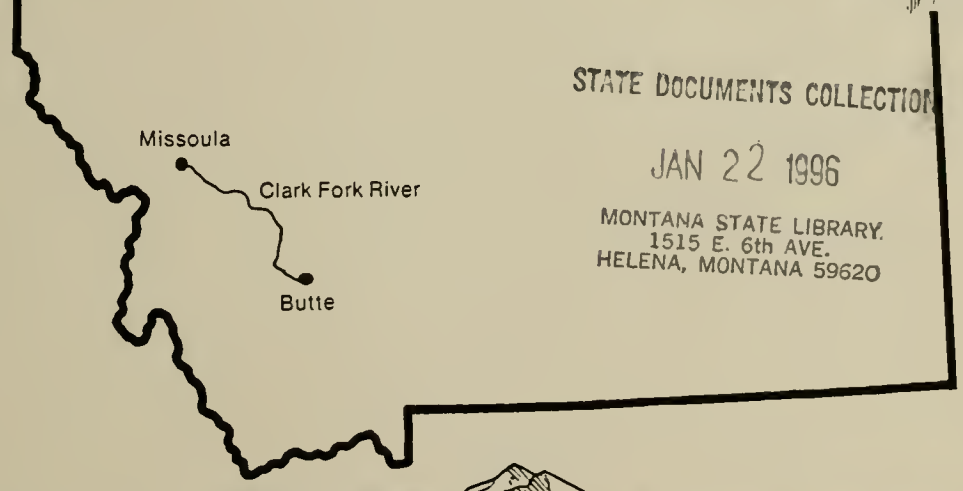
TATE OF MONTANA
NATURAL RESOURCE DAMAGE PROGRAM

REVISED REPORT AND REBUTTAL: ASSESSMENT OF DAMAGES TO ANGLERS AND OTHER RECREATORS FROM INJURIES TO THE UPPER CLARK FORK RIVER BASIN

OCTOBER 1995



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Revised Report and Rebuttal:

Assessment of Damages to Anglers and Other Recreators from Injuries to the Upper Clark Fork River Basin

Prepared for:

State of Montana
Natural Resource Damage Litigation Program

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October 18, 1995

Revised Report and Rebuttal:

Assessment of Damages to Anglers and Other Recreators from Injuries to the Upper Clark Fork River Basin

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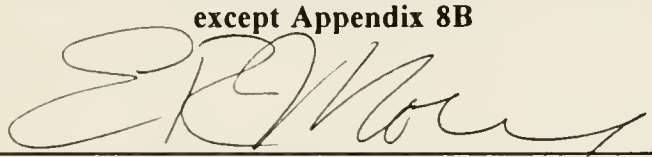
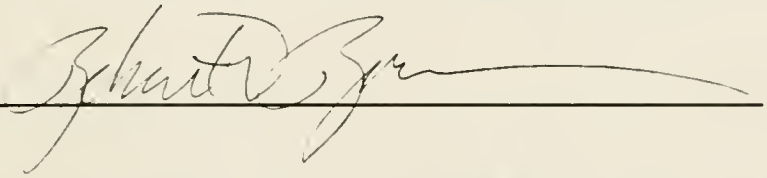
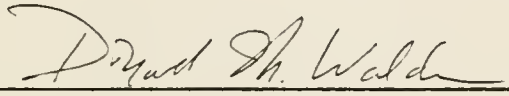
Edward R. Morey on all portions of the report except Appendix 8B



Robert D. Rowe on all portions of the report except Appendix 8B and the specific mathematical formulation and statistical estimation of the recreation demand model (Sections 5.2, 7.3.2, Appendicies 4A, 5A last paragraph, 5B, 5C, and 7A)



Donald Waldman on the Recreation Demand Model Specification, Econometric Procedures (in Chapters 4,5,6, 7 and appendicies) and Chapter 9



October 18, 1995

Rebuttal and Revised Assessment of Damages to Anglers and Other Recreators From Injuries to the Upper Clark Fork River Basin.

**Testifying Expert as to
Chapters 2 and 8, Appendix 8B
and references cited in said
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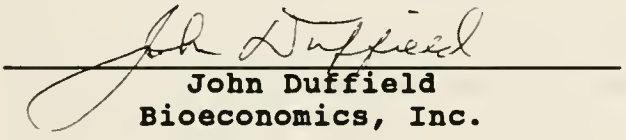

**John Duffield
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ACRONYMS

AAA	American Automobile Association
ARCO	Atlantic Richfield Company
cfs	cubic feet per second
MDFWP	Montana Department of Fish, Wildlife and Parks
ML	maximum likelihood
NRDA	natural resource damage assessment
RDM	recreational demand model
TCM	travel cost model
U.S. DOI	United States Department of the Interior
U.S. IRS	United States Internal Revenue Service
WTA	willingness to accept
WTP	willingness to pay

CHAPTER 1
INTRODUCTION

This revised Assessment of Damages to Anglers and Other Recreators is submitted in rebuttal to ARCO's expert witness reports which were submitted to the State of Montana in July 1995. This report and the results contained herein have been revised to reflect continued refinements by the State, and to reflect useful comments provided in the ARCO reports. Chapter 9 of this report is completely new and contains specific responses to certain other comments made by ARCO's witnesses regarding the previous version of this report.

1.1 OVERVIEW

Releases of hazardous substances from mining and mineral processing have injured natural resources in the upper Clark Fork River and Silver Bow Creek. These injuries include reduced fish stocks, contaminated soils, reduced vegetation, and reduced wildlife habitat and populations. As a result of these injuries, anglers and nonfishing recreators experience reductions in the services provided by the natural resources. These reductions in services are damages.

Reduced fisheries stocks lead to reductions in the expected catch rates for anglers at these sites and, combined with other natural resource injuries, cause damages to anglers who might choose to use the sites. Damages to anglers include, but are not limited to: (1) reduced benefits from trips to the injured sites due to reductions in the expected catch rates and quality at the sites; (2) losses associated with taking trips to substitute sites that are less preferred than the Clark Fork River and Silver Bow Creek if these sites were not injured by the releases of hazardous substances; (3) losses associated with taking fewer total fishing trips than they would take if the sites were uninjured; and (4) losses associated with individuals who do not fish but would have become anglers in the absence of injuries.

The injuries to fish stocks, vegetation, and wildlife also cause damages to individuals who enjoy nonfishing recreational activities such as hiking, picnicking, and wildlife viewing near rivers and streams. These individuals receive fewer benefits from their trips to the Clark Fork River and Silver Bow Creek than they would in the absence of injuries, incur losses by taking more trips to substitute sites that are less preferred, and incur losses by taking fewer nonfishing recreational trips to rivers and streams in the area than they would in the absence of injuries.

This report specifically estimates 1992 annual fishing and nonfishing recreation use value damages for Silver Bow Creek and the upper Clark Fork River between Warm Springs Ponds and the Milltown Dam due to the release of hazardous substances from mining and mineral processing. The impacted sites are depicted in Figure 1-1.

The remainder of this chapter introduces the injuries in the upper Clark Fork River Basin that affect fishing and nonfishing recreation, provides additional discussion of how these injuries cause damages to recreators, introduces the concepts, measures, and models used to estimate annual damages, and includes a summary of 1992 damages.

1.2 INJURIES IN THE UPPER CLARK FORK RIVER BASIN

This section of the report briefly introduces the natural resource injuries that affect recreational activities in the upper Clark Fork River Basin. Additional information on these injuries can be found in the injury assessment reports (Lipton et al., 1995a; Lipton et al., 1995b). In this and following discussions the term *injured conditions* refers to the 1992 conditions at the impacted sites. The term *baseline conditions* refers to the conditions that would exist at the sites if releases of hazardous substances had not occurred.

Releases of hazardous substances have injured natural resources in Silver Bow Creek and the Clark Fork River from Butte downstream to Missoula. Injured resources include fisheries, wildlife, and riparian vegetation. The period of releases extends back to the late 1800s, and releases continue today.

Fish in the assessment area have been and continue to be exposed to and injured by hazardous substances by direct contact with contaminated surface water and sediments as well as through food-chain consumption of contaminated prey (Lipton et al., 1995a). Specifically, the injuries to the fisheries result in smaller trout stocks than would exist without the injuries.[1] For example, Silver Bow Creek, which extends approximately 30 miles between Butte and Warm Springs Ponds, is unable to support any trout.

Studies have confirmed that riparian soils, vegetation, and wildlife habitat in the upper Clark Fork Basin along Silver Bow Creek and the upper Clark Fork River have been exposed to and injured by hazardous substances (Lipton et al., 1995b).

[1] This report focuses on trout because anglers predominantly target trout at southwestern Montana rivers and streams (see page 3-8).

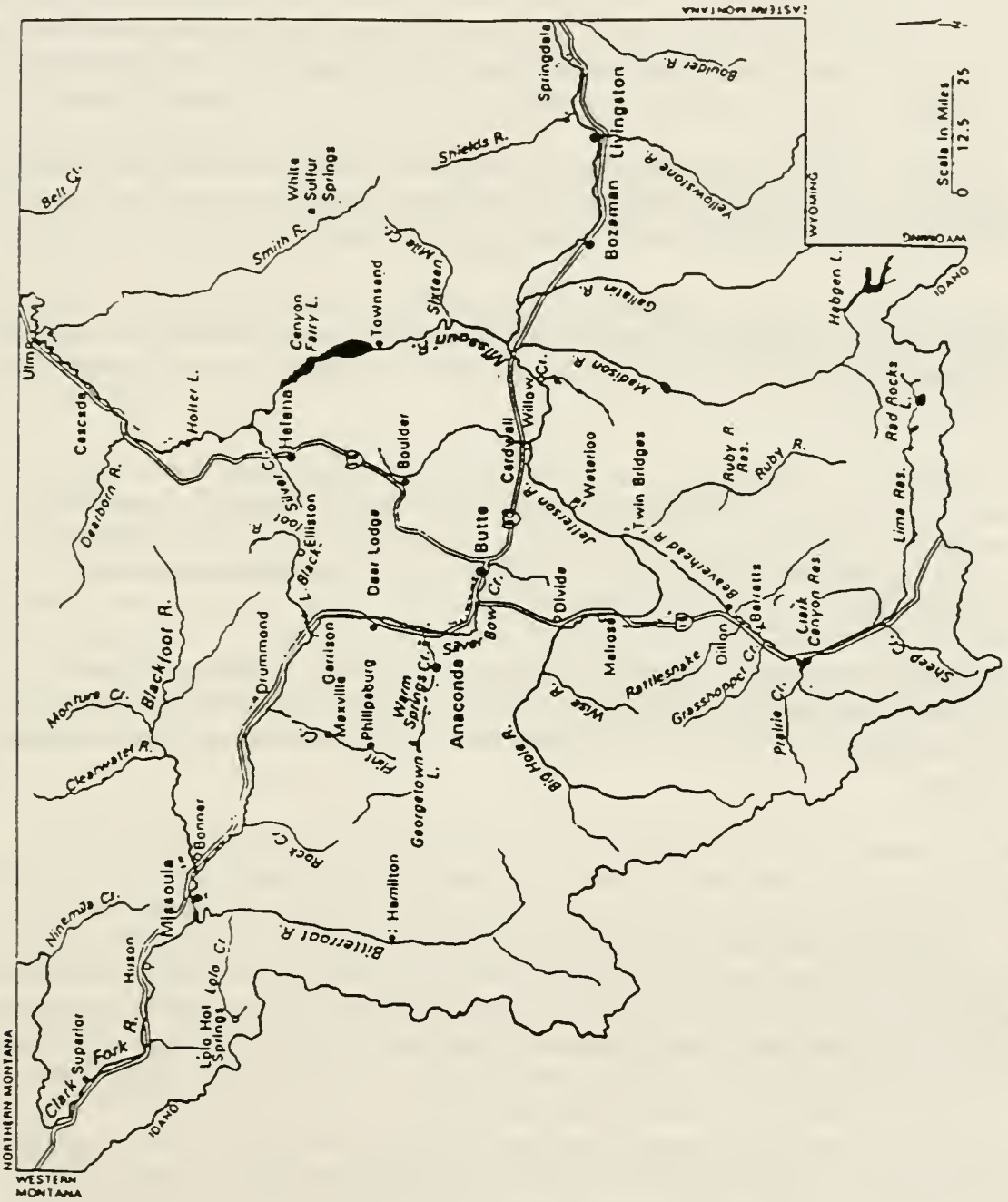

Figure 1-1
Map of Southwestern Montana

1.3 THE RESULTING DAMAGES TO ANGLERS AND OTHER RECREATORS

1.3.1 How Damages Arise

The expected catch rates for trout in Silver Bow Creek and the Clark Fork River are lower than they would be under baseline conditions. These reduced catch rates at the upper Clark Fork River and Silver Bow Creek lead to reduced service flows and to damages because:

1. Anglers continue to take trips to the injured sites, but they experience lower catch rates and lower fishing enjoyment than they would under baseline conditions. Because enjoyment of the site is reduced, anglers experience damages.

2. To minimize damages to themselves, anglers will substitute fishing trips to other sites rather than fish at the injured sites. The anglers are worse off because they would have preferred to have fished at the impacted sites under baseline conditions rather than at the substitute sites.

3. To minimize the damages to themselves, anglers will forgo taking some fishing trips and will participate in other activities rather than fishing at the injured sites. The anglers are worse off (damaged) because if the sites were in baseline conditions they would have preferred to take more fishing trips rather than participate in other substitute activities.

4. To minimize damages to themselves, some individuals who would have become anglers in the absence of injuries do not become anglers. These individuals are worse off (damaged) because they would have rather chosen to be anglers in the absence of injuries.

Because the second response is estimated to be one of the most significant responses and sources of damages, it is important to make clear that substituting fishing trips away from the injured sites to other fishing sites does result in damages to the anglers. Anglers who live close to the impacted sites must now travel farther to fish than they would otherwise have to, and may substitute to sites with the same or lower fishing quality than the impacted sites if the impacted sites were in baseline conditions. These individuals are damaged by experiencing both higher fishing costs and reduced enjoyment at the substitute sites as compared to what they would have experienced if Silver Bow Creek and the Clark Fork River were uninjured.

Anglers who live far from the impacted sites, and perhaps closer to other substitute sites, are also damaged if they would have chosen to fish at Silver Bow Creek and the Clark Fork River under baseline conditions. These individuals would be willing to incur higher travel costs to visit Silver Bow Creek and the Clark Fork River under baseline conditions rather than visit other closer sites because these added costs are less than the added value they assign to visiting the impacted sites under baseline conditions. For example, the angler might value

visiting a Clark Fork River site under baseline conditions at $25 more than visiting another closer site, but it costs $10 more in travel costs to visit the Clark Fork River site. By reducing the fishing quality at the Clark Fork River site the individual may save $10 in travel costs by instead visiting the substitute site, but he loses the $25 added value he assigned to being able to fish at the Clark Fork site under baseline conditions. In this example, the angler experiences trip damages of $15 because of injuries to the Clark Fork River.

At least two studies indicate that fishing activity levels at Silver Bow Creek and the Clark Fork River are well below use levels at other rivers and streams in southwestern Montana, even though Silver Bow Creek and the upper reaches of the Clark Fork River are close to Butte, and much of the upper Clark Fork River is near Missoula (Hagmann, 1979; McFarland, 1989). Results in this study corroborate those findings.

Nonfishing recreators also experience damages caused by injuries to surface water, sediments, wildlife, riparian habitat, and vegetation, all of which reduce the desirability of these sites for nonfishing recreation.

1.3.2 Willingness to Pay and Willingness to Accept Compensation

There are two conventional measures of the damages an angler experiences because the expected catch rates are not at baseline levels. One measure of damages is the angler's willingness to pay (WTP) above current expenditures to have available the baseline expected catch rates. Another measure of damages is the amount of money the angler would have to *be paid* to voluntarily forego the opportunity to experience the baseline expected catch rates. This is the angler's willingness to accept (WTA) compensation for the injury-level expected catch rates. For our model, WTA equals WTP.

1.3.3 Determinants of Damages to Individuals

Associated with each fishing trip are expected benefits and expected costs. The expected benefits from a trip to a site are an increasing function of the site's expected catch rate. Expected costs include transportation, lodging and equipment expenses, and the time spent in travel and at the site. The angler will not take a trip to a site if the expected costs exceed the expected benefits. The sum of expected net benefits received from all the trips taken is a measure of how the angler values the available fishing sites. The sum of these expected net benefits is how much the angler would be willing to pay above current expenditures to have the sites available and is positively related to each site's expected catch rate. Put simply, the sum of the expected net benefits from fishing trips will be greater the better the available fishing sites. WTP for the baseline (no-injury) expected catch rates is therefore the maximum the angler would pay to have available the baseline expected catch rates instead of the current, injury-level expected catch rates.

An angler's WTP for baseline expected catch rates at the Clark Fork River and Silver Bow Creek depends on how close the angler lives to these sites and other variables. Everything else constant, the lower an angler's trip costs to the Clark Fork River and Silver Bow Creek, the greater will be the angler's expected net benefits from trips to these sites, and the more the angler will be willing to pay for higher expected catch rates. Since the cost of a trip to site j is a decreasing function of how close one lives to site j, WTP will typically be higher for those who live near Silver Bow Creek and the Clark Fork River. Everything else constant, those whose characteristics (e.g., skill level, amount of available free time) make them more avid anglers will also typically have higher WTP. In addition, WTP for nonresidents is different because nonresidents and residents have different preferences for fishing Montana's rivers and streams.

1.3.4 Estimates of Willingness to Pay for Fishing from Previous Studies

Previous studies indicate that the WTP of anglers to have available the baseline expected catch rates at the Clark Fork River and Silver Bow Creek is substantial. The studies, for the most part, estimate net benefits per trip for the existence of specific rivers and streams in Montana. However, some provide estimates of WTP for either higher catch rates or bigger fish.[2] Many of these studies explicitly consider rivers and streams in the Clark Fork River Basin. For example, Duffield (1991) reports estimates of average net benefits per trip for each of the following four rivers: Rock Creek, the Blackfoot River, the Bitterroot River, and the upper Clark Fork River. These estimates of net benefits are derived from a recreation demand model and are $135 per trip for Rock Creek, $79 per trip for the Blackfoot, $55 per trip for the Bitterroot, and $44 per trip for the upper Clark Fork. Although these studies do not directly estimate annual WTP for the baseline catch rates at the Clark Fork River and Silver Bow Creek, they do indicate that trips to sites with high expected catch rates (e.g., Rock Creek) are valued much more highly than are trips to sites with lower expected catch rates. Currently, Rock Creek has the highest expected catch rate for trout of all of the rivers and streams in the upper Clark Fork River Basin. Using a contingent valuation survey that determines net benefits by asking each individual in a sample his or her willingness to pay for fishing sites and conditions, Duffield (1989) estimates that the average net benefits from a trip to Rock Creek are $218, and that individuals would pay on average $80 to $100 per trip not to have the conditions at Rock Creek deteriorate to a point at which the expected catch is reduced by half, a reduction comparable to the catch rate reduction one would experience by fishing the upper Clark Fork River rather than Rock Creek.

Duffield et al. (1988) report contingent valuation estimates of average net benefits per trip for 19 rivers in Montana. These estimates vary across rivers from $58 per trip for the Bitterroot to $228 per trip for the Madison; the average net benefit for a trip to the Clark Fork is $87.

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[2] In many of these studies, different estimates are often reported for the same scenario, and the estimates vary as a function of their underlying assumptions. We report representative estimates from these studies.

These estimates indicate that net benefits per trip are large and vary significantly as a function of the quality of the site visited. This study also indicates that willingness to pay for the availability of a site varies across anglers. It reports an average net benefit per trip over all 19 rivers of $8 for occasional users and $170 for those who are frequent users of the site; the average for all users is $117. This study also indicates anglers are willing to pay for both higher catch rates and bigger fish. Duffield et al. (1987) also report net benefits per trip that are high but vary significantly across rivers. In addition, they estimate that the net average benefits to anglers for river and stream fishing is $113 per trip.

Although these studies provide useful information, none of them directly estimates annual WTP for the baseline expected catch rates in the Clark Fork River and Silver Bow Creek. In addition, these previous studies measure willingness to pay on a per-trip basis, and per-trip measures cannot be easily transferred into annual estimates of damages unless one has some separate estimate of how many trips an individual will take to each site and how that number of trips would differ if the conditions of the sites were different. Therefore, we have undertaken state-of-the-art applications of accepted NRDA methods, including several new primary survey efforts, to estimate directly the damages resulting from the injuries to the Clark Fork River and Silver Bow Creek. The previous studies provide useful cross-check information.

1.4 METHOD OF ANALYSIS AND RESULTS

1.4.1 The Recreation Demand Model of Participation and Site Choice

A state-of-the-art recreation demand model was developed that predicts how many trips an angler takes (the participation decision) and the choice of sites as a function of trip costs, expected catch rates, sizes of sites, float access, campgrounds, and characteristics of the angler such as gender, age, skill level, years of experience, amount of available free time, and residency.[3] Parameters in the model were chosen to best explain the observed trip patterns for anglers who fish rivers and streams in southwestern Montana. The model was then used to estimate both the damages to anglers and how their behavior has been influenced by the existence of the lower level of expected catch rates as compared to baseline expected catch rates.

Recreation demand models date back to 1959 (see Clawson, 1959). The U.S. Department of the Interior (U.S. DOI) NRDA regulations recognize the methodology as "a best available procedure" to estimate use value damages for recreational sites [43 CFR § 11.83 (c)(2)(iv)].

[3] Recreation demand models are often referred to as travel cost models (TCMs) because travel costs are one of the significant determinants of how many trips an individual will take and which sites will be visited.

In addition, recreation demand models are widely used by the U.S. Forest Service, the DOI, and the U.S. Environmental Protection Agency to make policy decisions.

There are many variations on the basic recreation demand model (see Bockstael et al., 1991). The model developed here is a three-level, nested logit, random utility model of individual participation and site choice. The model is described in detail in Chapter 4.[4] It explicitly considers substitution across sites as a function of trip costs and site characteristics, so it can be used to predict how an angler's choice of sites would differ if the expected catch rates at the Clark Fork River and Silver Bow Creek were at baseline levels. The model also explicitly considers substitution in and out of fishing, so it can be used to predict how an angler's total number of trips to rivers and streams in southwestern Montana would change if the expected catch rates at the Clark Fork River and Silver Bow Creek were at baseline levels. Failure to include activities other than stream fishing would bias the damage estimates upward.[5] The need to address substitutability across sites and activities when estimating the damages from injuries at sites is further discussed in the DOI NRDA regulations [CFR 43 § 11.84 (f)].

Recreation demand model estimates of both participation and site choice require data on a sample of anglers, where for each angler in the sample there is a record of the total number of fishing trips the angler took during the summer season to rivers and streams in southwestern Montana and information on where the individual fished. There were no existing data sets with this type of information. We used an in-field intercept survey followed by telephone and mail follow-up surveys to obtain data for a sample of 443 Montana anglers on how many trips each of these anglers took to rivers and streams in southwestern Montana during the summer fishing season of 1992, and which sites they visited. Extensive catch data were also collected. The surveys and data collection effort are described in detail in Chapter 2.

From the estimated recreation demand model one can determine the expected net benefits an angler receives from fishing at the rivers and streams in southwestern Montana. This follows because a model that explains participation and site choice as a function of trip costs and site characteristics implicitly measures benefits. For example, when the model predicts that an angler will choose a more costly site with a high expected catch rate over a less costly site with a low expected catch rate, it is because the increase in benefits from the higher expected catch rate is greater than the increase in trip costs.

---

[4] Other random utility models of recreation demand include Bockstael et al., 1987a; Hanemann and Carson, 1987; Morey et al., 1991; Parsons and Kealy, 1992; and Morey et al., 1993.

[5] For more details, see Caulkins et al., 1985; Morey et al., 1991; Hanemann and Morey, 1992; and Morey et al., 1993.

1.4.2 Summary of Damages to Anglers

The 1992 annual WTP for the baseline expected catch rates was estimated for anglers who fish rivers and streams in southwestern Montana as a function of anglers' trip costs, age, gender, available free time, and other characteristics. For anglers who are residents of Montana, estimated annual WTP ranges from $0.01 to $42.96 with a mean of $6.31 and a median of $4.54. For anglers who are not residents of Montana, estimated annual WTP ranges from $1.19 to $40.35 with a mean of $14.17 and a median of $12.62. The $6.31 is the average of what resident anglers would pay to have available the baseline expected catch rates rather than existing catch rates, and $14.17 is the average of what nonresident anglers would pay to have available the baseline expected catch rates.

We estimate that in 1992 there were 71,239 resident anglers and 65,313 nonresident anglers actively fishing coldwater rivers and streams in southwestern Montana, and that they took a total of 721,000 trips to rivers and streams in Montana. The estimate of the damages to anglers in 1992 from not having available the baseline expected catch rates is about $1.4 million, $450,000 for residents and $926,000 for nonresidents (in 1992 dollars).[6]

1.4.3 Summary of Damages to Nonfishing Recreators

Many individuals take trips to rivers and streams in southwestern Montana for purposes other than fishing. The 1992 damages to nonfishing recreators were estimated as follows. First, the recreation demand model was used to estimate the number of additional fishing trips that would occur in the absence of injuries to the Clark Fork River and Silver Bow Creek. Second, the ratio of the change in nonfishing recreation trips to the change in fishing trips under baseline conditions was calculated. Third, the estimated number of additional fishing trips was then used to estimate that there would have been 8,959 more nonfishing recreation trips in 1992 to the impacted sites if there had been no injuries. Per-trip net benefits for a nonfishing trip with the baseline expected catch rates available is estimated to be $27.39 based on ratios of nonfishing recreation values to fishing values in the existing literature and per-trip fishing benefits estimated in this report (see Chapter 8 for details). This value is representative of trips that involve activities such as floating, picnicking, and hiking, the types of activities most frequently reported by nonfishing recreators on trips to southwestern Montana. The 1992 aggregate damages to nonfishing recreators are therefore $245,000 (in 1992 dollars).[7]

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[6] (71,239 multiplied by $6.31) and (65,313 multiplied by $14.17).

[7] (8,959 multiplied by $27.39).

1.5 REFINEMENTS

The following improvements and refinements have been made to the recreation demand model since the expert report on recreation damages was submitted in January 1995.

1. Five additional site characteristics were investigated to determine if they would increase the explanatory power of the model. The explanatory power of the model was improved by adding a variable for whether there is a campground(s) adjacent to the site, and by adding variables that explain whether a site is suitable for float fishing. Variables indicating the uniqueness of Silver Bow Creek in terms of attractiveness (it is ugly) and the uniqueness of the Upper Clark Fork 3 site in terms of access were found not to be significant determinants of participation and site choice.

2. The effect of price and expected catch are now allowed to vary depending on whether the angler is a resident or nonresident of Montana. This change allows residents and nonresidents to significantly differ in terms of their preferences for fishing Montana's rivers and streams. A separate recreation demand model was also estimated just for residents. This resident-only model generates results very similar to those of the full model that includes both residents and nonresidents.

3. The effect of the expected catch rates on participation and site choice varies by skill level.

4. For each nonresident in the sample, travel costs now vary across sites. Even though the variation in travel costs across sites for many of the nonresidents is very small in proportion to total travel cost, the refinement makes the travel costs more accurate.

5. The recreation model assumes that participation and site choice are not a function of income. This assumption is consistent with the ARCO recreation model assumption and simplifies the model.

6. The fact that anglers in the sample take more trips than is typical of the population is adjusted for by directly weighting choice occasions within the likelihood function. Weighting in this way has the effect that the predicted probabilities of participation mirror our best estimate of the population probabilities.

7. Observed catch is assumed to have a Poisson distribution: a distribution that realistically restricts each observed catch to be a nonnegative integer, and allows for the large number of observations with zero catch.

8. The expected catch rate for the Madison 2 site is assumed to be the simple Poisson average: the total reported catch at Madison 2 divided by the total number of hours fishing associated with that catch. Madison 2 has the largest number of hours of catch

data, 847 hours. The assumption anchors the expected catch rates for the other 24 sites (not including Silver Bow Creek) on the zero expected catch rate for Silver Bow Creek (there are no fish) and on the simple Poisson average for Madison 2.

9. A redundant parameter that previously existed in the model has been eliminated.

10. Vehicle operating costs are divided by two to reflect the fact that anglers in the sample reported, on average, two anglers per vehicle.

1.6 REPORT ORGANIZATION

The rest of the report is organized as follows. Chapter 2 describes the in-field, telephone, and mail surveys. Chapter 3 summarizes the data, including the results of these new surveys. Chapter 4 provides additional discussion of the recreation demand model used to estimate expected catch rates at fishing sites, to predict how often and where anglers fish, and to measure damages from natural resource injuries at the study sites. Chapter 5 provides the results of the model when estimated under current 1992 conditions at sites in southwestern Montana. Chapter 6 presents the stock/harvest model that estimates expected catch rates as a function of stock estimates. Chapter 7 then estimates changes in fishing use and the associated damages in 1992 if trout stocks and expected catch rates were at their baseline levels at Silver Bow Creek and the Clark Fork River. Chapter 8 presents the 1992 nonfishing recreation damage analysis. Chapter 9 provides rebuttal comments to the ARCO critiques of the State of Montana recreational damage assessment.

CHAPTER 2
DATA COLLECTION AND SURVEY DESIGNS

2.1 OBJECTIVES OF DATA COLLECTION

The objectives of the data collection effort were to acquire data necessary to estimate the damages to recreators from injuries to the upper Clark Fork River Basin, including:

- the number of resident and nonresident anglers who fish rivers and streams in southwestern Montana
- participation rates for fishing and nonfishing recreation at rivers and streams in southwestern Montana
- fishing site characteristics, including catch
- anglers' attitudes toward specific fishing sites and fishing in general at southwestern Montana rivers and streams
- demographic and socioeconomic characteristics of anglers.

Estimates of the number of resident and nonresident anglers and the average number of trips for each group were obtained using angler license data for Montana and data collected by the 1991 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (U.S. DOI, 1993). The data collection effort also included primary survey efforts. The primary data collected from a sample of anglers and other sources include individual trip records for each sampled angler for the 1992 summer season (how often each angler fished and the destinations on some of the trips from May through September) for all rivers and streams in southwestern Montana. Also collected were individual reported catch data, data on the sizes of various sites and other site characteristics, data on trip costs, demographic and socioeconomic data that influence where and how often anglers fish, and data on angler attitudes about fishing at rivers and streams in southwestern Montana.

Four survey components were used to collect primary data, including:

- an in-field intercept survey
- an in-field postcard survey
- a telephone follow-up survey of anglers
- a mail follow-up survey of anglers.

2.2 RIVERS AND STREAMS IN SOUTHWESTERN MONTANA

The data collection effort focused on all rivers and streams in southwestern Montana. These rivers and streams are predominantly cold water fishing sites where the main species sought for recreational fishing is trout.[1] We divided Montana into five regions. The regions were chosen to reflect population concentrations with the assumption that anglers take more fishing trips in their own region than in other regions. We define four regions in southwestern Montana: Missoula (M), Butte/Dillon (BU), Helena (H), and Bozeman (BZ). A fifth region (Other) is used to categorize all fishing trips to Montana rivers and streams outside of southwestern Montana. While data were collected for all rivers and streams in southwestern Montana, there are more complete data for some rivers and streams (sites chosen for "intensive study") than for others. Catch data were only collected for the 26 sites chosen for intensive study.[2] The 26 intensively studied sites and the four regions in southwestern Montana are listed and defined in Table 2-1 and are represented on the map of southwestern Montana in Figure 2-1.[3] The six impacted sites in the upper Clark Fork River Basin, as listed in Table 2-1, are: (#1) UCF 1; (#2) UCF 2; (#3) UCF 3; (#12) UCF 4; (#13) UCF 5; and (#14) Silver Bow Creek.

The 26 intensively studied sites include the injured sites in the Clark Fork Basin, substitute sites, and comparable sites. Criteria for choosing the set of sites for intensive study included geographic distribution over southwestern Montana, variability in site characteristics such as expected catch rates, and sites that account for a significant portion of fishing trips taken in southwestern Montana. For a given angler, distances to the sites vary across the 26 sites. This geographic variation is needed to determine the importance of distance in determining where and how often anglers fish. These sites are also highly varied in site characteristics such as size and expected catch rate because site characteristics are important in determining where and how often anglers fish. To determine statistically the importance of these variables, they must also vary across sites. Additionally, sites chosen for intensive study in a given region are expected to be the destinations of a significant percentage of all fishing trips to the region so that the statistics obtained are representative of the majority of fishing trips. Finally, the catch rate of each site chosen for intensive study is roughly homogeneous across the site. Therefore, the variation in expected catch rate within a site is expected to be less significant in explaining recreation patterns than the variation in catch rates across sites.

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[1] Chapter 3 shows that the data indicate trout is the primary species sought by anglers.

[2] Originally, 27 rivers and streams were chosen for the analysis, but one was eliminated before the data collection effort began. Warm Springs Ponds was initially included because the upper Clark Fork River has its headwaters there, but this site was not open for much of the summer of 1992. Some of the 26 sites actually represent only a stretch, or reach, of the river or stream, not the entire river or stream.

[3] Hereafter, the term *southwestern Montana* indicates the area depicted in Figure 2-1.

Table 2-1
List of Intensively Studied Sites*

Missoula Region	
1.	Upper Clark Fork 1 (UCF 1) — Bonner to Rock Creek
2.	Upper Clark Fork 2 (UCF 2) — Rock Creek to Flint Creek
3.	Upper Clark Fork 3 (UCF 3) — Flint Creek to L. Blackfoot
4.	Middle Clark Fork — Spurgin Rd. to Huson
5.	Rock Cr. — 1 mile up from Clark Fork to Siria
6.	Flint Cr. — Maxville to Black Pine Rd.
7.	Bitterroot 1 — Maclay Br. to Chief Looking Glass
8.	Bitterroot 2 — Angler's Roost to Hannon Mem.
9.	Lolo Cr. — Mormon Cr. to Lolo Hot Springs
10.	Blackfoot — Bonner to Whitaker Br.
11.	L. Blackfoot — Cutoff Rd. to Elliston
Butte/Dillon Region	
12.	Upper Clark Fork 4 (UCF 4) — L. Blackfoot to Perkins L.
13.	Upper Clark Fork 5 (UCF 5) — Perkins L. to Pond 2 Outfall
14.	Silver Bow Cr. — Ponds to Butte
15.	Warm Springs Cr. (WSC) — Fish Hatchery to Meyer's Dam
16.*	Warm Springs Ponds
17.	Big Hole 1 — Pennington Br. to Brown's Br.
18.	Big Hole 2 — Melrose to Divide
19.	Jefferson 2 — Waterloo to Twin Bridges
20.	Beaverhead — Barretts to Clark Canyon
28.	Jefferson 1 — Willow Cr. to Cardwell
Helena Region	
21.*	Missouri 1 — Ulm to Cascade
22.	Missouri 2 — Dearborn R. to Holter Dam
Bozeman Region	
23.	L. Yellowstone — Springdale to Livingston
24.	Gallatin — Shedd Br. to Spanish Cr.
25.	E. Gallatin — Spain L. Br. to Griffen Dr.
26.	Madison 1 — Cobblestone to Beartrap
27.	Madison 2 — Varney to Lyons

* Sites 16 and 21 were not included for study. Site 21 was omitted prior to any survey implementation. Site 16 is not a river or stream and was not open for much of the summer season.

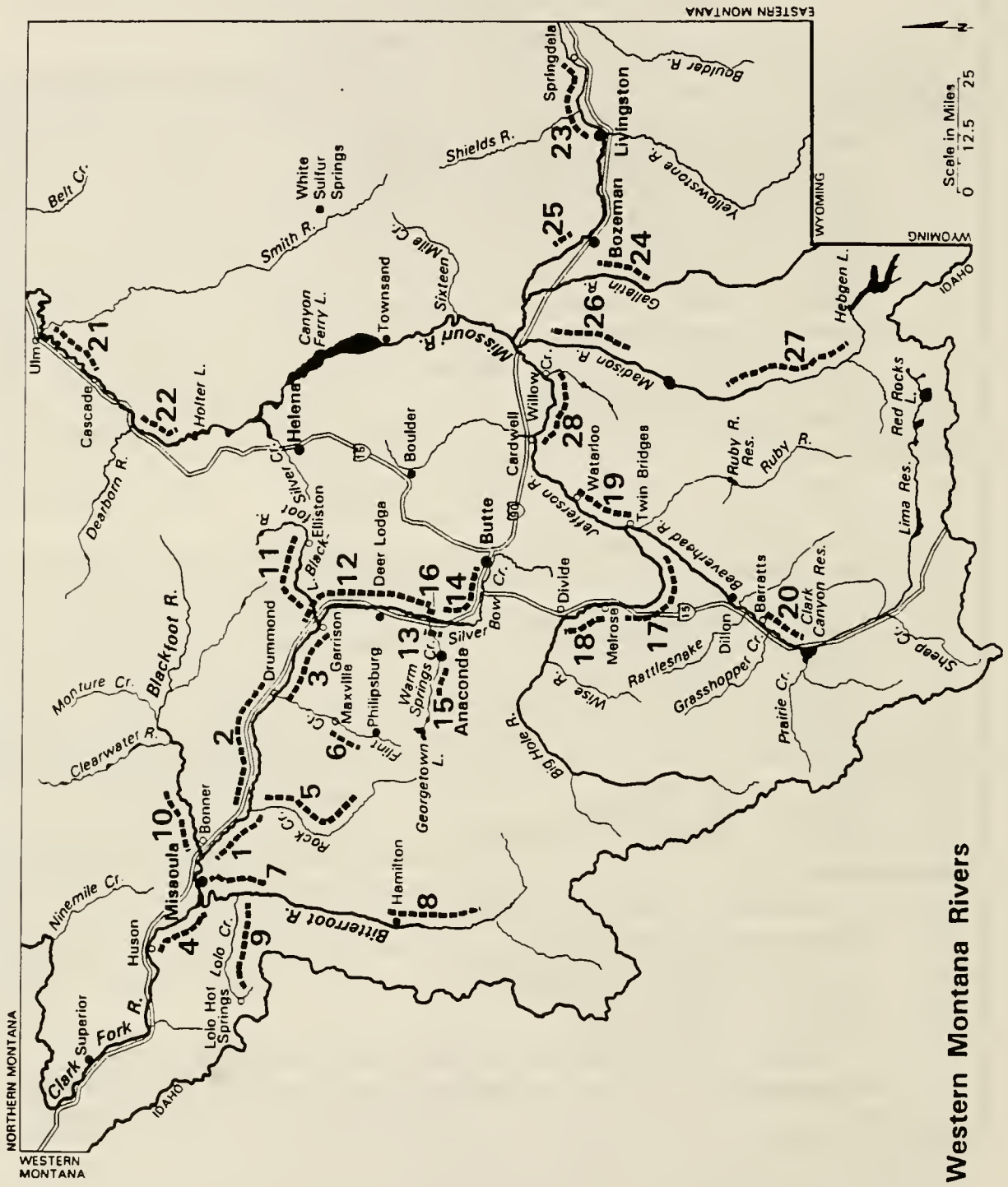

Figure 2-1
Map of Southwestern Montana Showing the 26 Intensively Studied Sites

2.3 PRIMARY DATA COLLECTION AND SAMPLE OF RECREATIONAL ANGLERS

One of the goals of the primary data collection effort was to obtain an accurate record of river and stream fishing activities for a set of anglers for the 1992 summer fishing season. The survey strategy was composed of the following sets of activities:

- contacting anglers and nonfishing recreators with an in-field intercept survey and an in-field postcard survey
- acquiring data on catch and time fishing
- attaining complete trip records by following a subgroup of the intercepted anglers for the rest of the season with telephone and mail surveys.

This strategy of using multiple survey instruments and repeated contacts was adopted to minimize or eliminate the potential for recall bias in the reporting of the number and destinations of trips anglers took during the season. The survey efforts are further described below.

In-Field Intercept Survey

In-field intercept surveys were conducted to establish initial contact with anglers who would be followed up throughout the rest of the season and to collect site-specific catch data. The intercept survey contains four sections: set-up questions, questions about the angler's intercept trip including catch data for the trip, questions about trips prior to the intercept trip, and questions about the angler.[4] Respondents were asked on this survey how many trips they had taken since May 1 and where they went on their most recent trips.

Intercept surveys were conducted at each of the 26 intensively studied sites on various days and times throughout the season as determined by a stratified sampling plan (Duffield et al., 1992a). The sampling plan was designed so that each angler at a given site had an equal probability of being intercepted during the season (Duffield et al., 1992b). Intercepts began on May 1 and ended on August 23, 1992. The intercept season was divided into eight "waves" tied to the follow-up telephone and mail survey strategy to minimize the potential for recall bias in the reporting of trip data. Each wave lasted approximately two weeks. Exact wave dates are reported in Table 2-2. Intercepts were conducted by a field crew trained to follow a strict routine, schedule, and protocol. Details on this protocol, the sample design, and the routes followed can be found in *The Survey Agent Training Manual* (Duffield, 1992). A total

[4] The intercept survey questionnaire was pretested twice in April 1992, and the final version appears in Appendix 2A.

of 1,951 anglers were intercepted in the 1992 summer season, and of those intercepted, 98 percent completed some or all of the questions. At the end of each intercept wave, all intercept questionnaires were sent in for double-entry coding.

Table 2-2
Definitions of Waves for Intercept Survey

Wave One: May 1st through May 17th
Wave Two: May 18th through May 31st
Wave Three: June 1st through June 14th
Wave Four: June 15th through June 28th
Wave Five: June 29th through July 12th
Wave Six: July 13th through July 26th
Wave Seven: July 27th through August 9th
Wave Eight: August 10th through August 23rd

In-Field Postcard Survey

The postcard survey includes questions relating to fishing and nonfishing recreational use. A copy of the postcard appears in Appendix 2A. It was used as a method to count angler and nonangler recreation visitation at each of the 26 intensively studied sites. The postcard survey was implemented concurrently with the in-field intercept survey by the same survey agents during the period May 1 through August 23, 1992. Agents placed a postcard with return postage on all automobiles encountered at the rivers chosen for intensive study, and all license plate numbers of automobiles on which postcards were placed were recorded to monitor postcard return rates. Recreators were asked to return the postcards through the mail. Activities for all people in each automobile were recorded on the postcard.

The postcards were left on automobiles at pre-specified sampling locations. These locations were chosen primarily to support the recreational fishing analysis. Including locations that may support nonfishing recreation, rather than fishing recreation, was not a primary consideration, and nonfishing sites may be proportionately undersampled. Therefore, nonfishing recreation participation may be understated.

The overall postcard response rate for all 26 sites is 47 percent and includes 2,224 returned postcards covering the activities of 6,346 recreational visitors in southwestern Montana. Detailed response rates are provided in Table 2-3 and differ across sites. The overall postcard response rates will differ across sites if the proportion of anglers to other recreators differs across sites and if the two groups have different response rates. Both conditions are likely.

Follow-Up Group

A group of individuals from each intercept wave was chosen to be followed up for the rest of the season based on a stratified random sampling procedure using the postcard proportions for

Table 2-3
Postcard Response Data

Site	Total Postcards Distributed	Total Postcards Returned	Percent Returned
UCF 1	116	76	65.5%
UCF 2	62	32	51.6%
UCF 3	35	10	28.6%
Middle CF	285	125	43.9%
Rock Cr.	276	115	41.7%
Flint Cr.	32	23	71.9%
Bitterroot 1	226	108	47.8%
Bitterroot 2	148	88	59.4%
Lolo Cr.	141	57	40.4%
Blackfoot	326	136	41.7%
L. Blackfoot	31	24	77.4%
UCF 4	11	4	36.4%
UCF 5	29	12	41.4%
Silver Bow Cr.	1	0	0.0%
WSC	1	1	100.0%
Big Hole 1	219	92	42.0%
Big Hole 2	219	94	43.0%
Jefferson 2	177	90	50.8%
Beaverhead	326	119	36.5%
Jefferson 1	153	75	49.0%
Missouri 2	518	251	48.5%
Yellowstone	209	95	45.5%
Gallatin	223	133	59.6%
E. Gallatin	75	47	62.3%
Madison 1	306	149	48.7%
Madison 2	600	268	44.7%

fishing activity at the 26 sites.[5] Returned postcard data were used to select the follow-up sample because the intercept survey may misrepresent the actual proportions of all anglers who are at each of the sites. For example, the intercept survey may include a higher proportion of anglers at less popular sites and a lower proportion of anglers at more popular sites because of limitations on the survey agent's on-site time.

Because the postcards were placed on every automobile at all sites, the postcard proportions of anglers across sites provide better estimates of the proportions of anglers at each of the 26 sites than do the intercept survey proportions. With similar postcard return rates across sites for anglers, the number of postcard anglers at a site divided by the total number of postcard anglers at all sites is a reliable estimate of the proportion of anglers at that site.[6]

For each intercept wave, a three-step sampling process was used to generate the follow-up sample:

- The total number of anglers was selected to be included in the follow-up sample.
- The postcard proportions of anglers at the 26 sites were used to determine the number of anglers to be selected from those intercepted at each site.
- A random sample of anglers at each site was drawn to equal the target sample size for each site.

As a result of this procedure, the percentages of anglers at each intercept site who were successfully followed up for the rest of the season are similar to the percentages of anglers at each site measured by the postcard survey for all waves (see Table 2-4). The percentages in the last column of Table 2-4 (anglers in the follow-up survey) are also reliable estimates of

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[5] Some intercepted anglers were not considered candidates for follow-up because the information they provided on the intercept survey was incomplete. For example, if the address was missing, an angler could not be followed up.

[6] This is true regardless of the number of nonfishing recreators at the sites or their propensity to return the postcards. For example, suppose there are only two sites, A and B, and in the population 100 anglers visit site A and 50 visit site B, so that the ratio of anglers at A to the anglers at B is two to one. An interviewer places postcards on 200 cars at site A (100 anglers and 100 other recreators), and 150 cars at site B (50 anglers and 100 other recreators). Suppose that two-thirds of anglers and one-third of nonfishing recreators are predisposed to return postcards. At site A there will be 67 postcards returned by anglers and 33 returned by nonanglers, and at site B there will be 33 postcards returned by anglers and 33 returned by nonanglers. The proportion of anglers at sites A and B to total anglers reported by the postcards are 67/100 and 33/100, respectively, maintaining the two to one ratio. Note that the overall postcard response rates are not equal, but 50 percent and 44 percent.

Table 2-4
Comparison of Postcard Angler Proportions with Proportions of Intercept Anglers Followed Up

River	Anglers in the Postcard Survey		Anglers in the Follow-Up Survey	
	#	% of Total	#	% of Total
UCF 1	79	2.5%	11	2.1%
UCF 2	17	0.5%	2	0.4%
UCF 3	11	0.3%	2	0.4%
Middle CF	110	3.4%	17	3.3%
Rock Cr.	148	4.6%	31	6.0%
Flint Cr.	36	1.1%	10	1.9%
Bitterroot 1	67	2.1%	10	1.9%
Bitterroot 2	221	6.9%	31	6.0%
Lolo Cr.	36	1.1%	6	1.2%
Blackfoot	91	2.8%	6	1.2%
L. Blackfoot	39	1.2%	7	1.4%
UCF 4	4	0.1%	1	0.2%
UCF 5	28	0.9%	6	1.2%
Silver Bow	0	0.0%	0	0.0%
WSC	1	0.0%	0	0.0%
Big Hole 1	178	5.6%	36	7.0%
Big Hole 2	183	5.7%	21	4.1%
Jefferson 2	144	4.5%	27	5.3%
Beaverhead	201	6.3%	41	8.0%
Jefferson 1	75	2.3%	15	2.9%
Missouri	469	14.7%	66	12.9%
Yellowstone	198	6.2%	20	3.9%
Gallatin	125	3.9%	21	4.1%
E. Gallatin	60	1.9%	14	2.7%
Madison 1	127	4.0%	22	4.3%
Madison 2	552	17.3%	90	17.5%

the season trip proportions for the population of anglers who fish rivers and streams in southwestern Montana. Looking ahead, these trip proportions are similar to the season trip proportions for trips taken by the sample anglers followed throughout the season, indicating that the trip proportions in the sample mimic the trip proportions in the population.

Of the 1,951 intercepted anglers, 833, or 43 percent, were chosen for follow-up. Members of the follow-up group were asked to participate in the telephone survey and the final mail survey. Within two weeks following each intercept survey wave, the follow-up sample members were selected and were sent a logsheet for recording trips taken after the intercept survey. The map delineating the four regions in southwestern Montana and the 26 intensively studied sites was also sent to aid respondents. The data collected on the log were then reported during the telephone survey or on the mail survey. The logsheet was used to help minimize the potential for recall bias. Each respondent was encouraged to use the logsheet and had the opportunity to request a new logsheet during each telephone interview. Five versions of the logsheet were used throughout the season. A copy of each logsheet can be found in Appendix 2A. The versions differ only in the start or end dates of the periods covered by the logs. The differences between logsheets were necessary because of the staggered schedule of the intercept survey waves and the follow-up telephone survey waves.

Telephone Survey

Repeated telephone survey waves were conducted to obtain information on anglers' most recent fishing trips. These data were combined with the intercept survey data and the mail survey data to develop the trip records used in the recreation demand model. A copy of this telephone survey appears in Appendix 2B. During each telephone contact, respondents were asked how many times they had fished since they had last been contacted and to provide information about the destinations for three trips, or all trips if the individual took fewer than four trips since the last contact. This type of approach minimizes the potential for recall bias.

Anglers intercepted earlier in the season received more calls than those intercepted later, and the total number of telephone contacts ranged from zero to two.[7] Calls were separated by approximately equal intervals. For example, if an angler was designated to be contacted by telephone and if two months were left in the season, he or she would have been telephoned approximately one month following the intercept, and then contacted by mail at the end of the season. The telephone survey was conducted using standard procedures by the University of

[7] Those intercepted from May 1 through June 28 (waves one through four) received two telephone calls while those intercepted from June 29 through July 26 (waves five and six) received one. Anyone intercepted after July 26 (waves seven and eight) did not receive any telephone calls, but a subsample was followed up using the final mail survey.

Idaho Social Survey Research Unit. The overall response rate to the telephone survey was 83 percent.[8]

End-of-Season Mail Survey

The final survey instrument implemented was an end-of-season mail survey of the 833 anglers chosen to be in the follow-up group. This was the last contact of the season and was used to complete angler trip records and to collect other data. On the mail survey, anglers were asked about all trips taken since the date of last contact, which could have been the date of the first telephone call, the second telephone call, or the intercept. Thus, even if an angler was not reached for the telephone survey, we still have a record of the total number of trips if the angler completed the mail survey. The mail survey asked the angler to provide detailed information about the destinations on three of the angler's fishing trips since the date of last contact. It was also used to acquire additional information on anglers' perceptions about and attitudes toward selected fishing sites and fishing in Montana in general, the effect of increasing catch rates on their expected visitation at selected sites, socioeconomic and demographic characteristics, nonfishing recreation, and trip characteristics. Some questions on the survey were specifically designed to acquire travel-cost information from nonresidents.

Two versions of this survey were mailed in equal proportions to the anglers in the follow-up group. A copy of each version of this instrument is in Appendix 2C. The separate versions allow investigation of a broader range of sites in Questions 4 through 8 and Questions 12 through 20 than one version would have allowed. These questions deal with angler rankings of sites and then undertake a contingent ranking and participation analysis for selected sites if fishing conditions at the sites were to change. The mail survey received two rounds of in-field pretesting during the late summer of 1992.

The mail survey was implemented from September 11 through November 1992 using a Dillman (1978) repeat mail procedure as outlined in Table 2-5. To increase response rates, a telephone follow-up (not the telephone survey discussed above) was conducted during the week of November 2, 1992 to encourage those who had not yet returned the mail survey to do so. Of those contacted in this subsequent telephone survey, 90 percent agreed to return the mail survey. We asked those who refused to complete the mail survey to answer a few questions over the telephone to obtain demographic and trip record information for these individuals. Eight anglers of sixteen total who were contacted by telephone and who refused to complete the mail survey provided answers to the partial telephone survey.[9]

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[8] Detailed response rates to the telephone survey by phase (first or second call) and by wave are reported in Appendix 2B.

[9] Copies of the telephone follow-up survey for the mail survey, the cover letters, and the reminder postcard (see Table 2-5) can also be found in Appendix 2C.

Table 2-5
Steps of Dillman's Repeat Mail Procedure

1.	First full mailing	This included a cover letter about the survey, a map identical to the one included with the logsheet, and a copy of the instrument. The first mailing occurred on September 11, 1992.
2.	Reminder postcard	Mailed to all respondents one week later on September 22, 1992.
3.	Second full mailing	This included a reminder letter, another map, and another copy of the survey instrument. This mailing was made to those from whom we had not received a completed survey form or we had a bad address return and occurred on October 9, 1992.
4.	Telephone follow-up for mail survey	The main purpose of this telephone follow-up (not to be confused with the mid-season trip record telephone survey) was to encourage nonrespondents to the final mail survey to complete and return the survey. The telephone follow-up for the mail survey occurred between November 2, 1992 and November 5, 1992.

As reported in Table 2-6, the net overall response rate to the mail survey is 62.7 percent, which is adjusted for bad addresses identified with the mail survey effort, yielding 513 respondents (505 from the mail survey plus 8 more from the telephone follow-up to the mail survey) for whom we have trip records for the 1992 summer season. There is no significant variation in response rates across the two survey versions.

Table 2-6
Mail Survey Response Rates

Description	Total	Version 1	Version 2
Questionnaires mailed	833	417	416
Bad addresses	28	12	16
Adjusted sample	805	405	400
Total response	507	258	249
Useable returns	505	258	247
% Useable returns of adjusted sample	62.7%	63.7%	61.8%
Total number of residents*	297	151	146
Total number of nonresidents*	216	113	103

* Includes responses from the telephone follow-up to mail survey.

2.4 SUMMARY

With number of fishing trips taken to Montana rivers and streams during the 1992 summer season for each of the anglers in our sample. Additionally, we have destination information on up to 11 trips for each of these anglers (up to 2 trips from the intercept survey, up to 6 trips from the telephone contacts, and up to 3 trips from the final mail survey); at the very least we have destination information about 1 intercept trip. We also have information on individual catch, trip characteristics such as expenses incurred, data on angler attitudes and opinions, and demographic and socioeconomic characteristics of anglers.

CHAPTER 3
BASIC SURVEY RESULTS

Summarized and discussed in this chapter are angler license data for Montana, relevant data from the 1991 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (U.S. DOI, 1993), and the data collected by the components of our primary data collection effort (the in-field intercept survey, the telephone follow-up survey, and the mail follow-up survey). Analysis of these data sheds light on where and how often anglers fish in southwestern Montana and on angler attitudes and perceptions about fishing in Montana. Such analyses help determine which variables should be included in the recreation demand model. For example, the data from the mail survey indicate expected catch rates are an important determinant of where anglers fish. As a result, expected catch rates are an important component of the recreation demand model.

It is most useful to consider the data from all data sources together. For example, trip data, which contain information on the total number of angler trips and some of the destinations, are compiled using combined data from the in-field intercept survey, the telephone follow-up survey, the mail survey, and the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. The rest of this chapter is divided into topics for discussing the data, rather than discussing the data from each survey separately.

The remainder of this chapter is divided into the following major topics: number of anglers and number of trips, angler perceptions and attitudes, the calculation of observed catch rates, and fishing trip patterns and characteristics. Tabular summaries of the results are provided in the chapter and in Appendix 3A.

3.1 NUMBER OF ANGLERS AND NUMBER OF TRIPS

On the basis of the license data and data collected by the 1991 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (U.S. DOI, 1993), we estimate that there are approximately 71,000 Montana residents active in river and stream fishing in southwestern Montana. These resident anglers took approximately 629,000 fishing trips to Montana rivers in 1992. There are approximately 65,000 nonresident anglers active in river and stream fishing in southwestern Montana. These anglers took 92,000 trips to Montana rivers.[1] According to published and unpublished calculations by the U.S. Fish and Wildlife Service, the average number of river trips for resident anglers who fish rivers and streams is 8.8 per year, and the

[1] For details on these calculations see Appendix 3B.

average for active nonresidents is 1.4. Almost as many nonresidents fish rivers and streams in southwestern Montana as do residents; this fact is significant and indicates that ignoring the damages to nonresident anglers will grossly underestimate damages.

Nonresidents take fewer trips per angler per year than residents (1.4 vs. 8.8). This is consistent with much higher trip costs for nonresidents. The cost of a trip for nonresidents ranges from $485 to $1,123 with a mean of $840, whereas trip cost for residents ranges from $10 to $310 with a mean of $77. Higher trip costs for nonresidents do not completely explain the difference in average number of trips. That nonresidents took 92,000 trips even though costs are much higher suggests that nonresident trip patterns are less sensitive to trip costs, which is confirmed by the recreation demand model. The lower average number of trips for nonresidents should not be used to infer they value site changes less than residents; quite the opposite is true (see Chapter 7).

3.2 ANGLER PERCEPTIONS AND ATTITUDES

The surveys were designed to reveal how anglers evaluate different sites and to examine how important different site characteristics and respondent characteristics are in determining how often, and where, anglers fish in southwestern Montana.

3.2.1 Catch Rates and Species are Important to Anglers

The Importance of Catch and Other Site Characteristics

Natural resource injuries at the Clark Fork River and Silver Bow Creek sites can be expected to impact fish stocks, and therefore expected catch rates. In most studies of recreational fishing use and economic valuation, catch rates are found to be important factors in the enjoyment of fishing, in the selection of fishing sites, and in decisions on how often to go fishing. Therefore, it is important to ascertain whether anglers who fish in southwestern Montana are concerned about the catch at different sites. The survey data suggest that anglers consider catch to be very important to the recreational fishing experience.

The mail survey (Q3) asked respondents to rank seven site characteristics, from not at all important to very important in their decision about where to fish. The average rankings for these site characteristics are reported in Table 3-1. On average, anglers rated the number and size of fish as the most important site characteristics that determine the selection of fishing sites.

Table 3-1
Mean Importance Ratings (and standard errors of the mean)
of Fishing Site Characteristics
(mail survey Q3)

Species of fish	4.75 (0.083) N = 484
Number of fish	5.00 (0.066) N = 491
Size of fish	5.02 (0.069) N = 486
Catch and release stretches	4.48 (0.098) N = 486
Proximity to angler's home	3.97 (0.102) N = 483
Scenic quality	4.95 (0.076) N = 487
Avoid unattractive site	4.64 (0.084) N = 488
Fish at many sites	4.90 (0.071) N = 484
Quality of nonfishing recreation	3.72 (0.084) N = 486

Ratings: 1 = *not at all important* to 7 = *very important.*

Rating of Sites for Catch and Other Characteristics

The above results suggest that catch rates and other site characteristics are important to the selection of a site. Questions 4 through 7 of the mail survey asked respondents to rate seven sites (Big Hole 2, Rock Creek, Madison 2, Missouri, Jefferson 2, Upper Clark Fork 4, and the combination of Upper Clark Fork 2 and 3) on the basis of:

- familiarity with the site (from 1 = *not at all familiar* to 7 = *very familiar*)
- perceptions about the largest fish they could expect to catch (from 1 = *below average* to 7 = *above average*)
- perceptions about the number of fish they would expect to catch in four hours of fishing (from 1 = *below average* to 7 = *above average*)
- perceptions about the quality of nonfishing recreation activities at the site (from 1 = *below average* to 7 = *above average*).

Anglers could also provide *Don't Know* responses to the last three site characteristics if they felt they were unfamiliar with the site.

In all four categories, the Clark Fork sites scored the lowest in terms of average angler ratings. Madison 2 ranked highest in all categories except the quality of nonfishing recreation, in which it ranked third. The high rankings for Madison 2 are consistent with prior economic

value studies comparing this site to other sites (see Duffield et al., 1988). In Chapter 5, we show anglers' perceptions about the relative quality of fishing sites in southwestern Montana are highly correlated with the expected catch rates at these sites. With accurate perceptions on site characteristics, and with catch being an important site characteristic, we can expect that decisions on trip-taking behavior will reflect differences in expected and actual catch rates across different sites. See Table 3-2 for specific rating averages for all seven sites.

Expected Changes in Fishing Behavior as Catch Changes

In the subsequent analyses (Chapters 4 through 7), the recreation demand model will predict, based on current behavior, how changes in expected catch rates for trout will impact recreation behavior. The mail survey included questions to investigate what anglers state their expected behavior would be if catch rates for trout changed at selected sites (Q12 through Q21). This provides a comparison between the recreation demand model's predicted changes in population behavior and how anglers state they would change their behavior in response to hypothetical changes in catch rates.

The analysis is conducted through a contingent behavior scenario where the angler is presented a change in the expected catch rate at a site and asked, as a result: how he would rate the site; how many more or fewer visits he would have taken to the site in 1992; and how many more or fewer visits he would have taken to other sites in 1992. In summary, the responses to the contingent behavior questions indicate that in the absence of injuries (i.e., conditions with higher expected catch rates) anglers would take more trips to the currently injured sites, and that some of these trips will be substitutions from other sites and some will be new fishing trips. Looking ahead to Chapter 7, this is what the recreation demand model predicts.

Four sites were considered in the contingent behavior analysis, which included two sites in each of two survey versions: Big Hole 2 and the combination of Upper Clark Fork 2 and 3 in Version 1; and Madison 2 and Upper Clark Fork 4 in Version 2. Each survey version included a Clark Fork River site and another site so as not to communicate that the survey was exclusively focused on the Clark Fork River, but rather had a broad focus. Different anglers were asked about different changes in the level of expected catch in four hours of fishing at these sites. For example, some anglers were asked about an increase in the catch rate at Big Hole 2 of two fish per four hours while others were asked about a decrease in the catch rate at Big Hole 2 of minus four fish per four hours.

At sites with high expected catch rates, the survey asked about changes in catch rates that included modest increases and modest to large decreases because large increases in catch may have seemed unrealistic. Increases of one, three, and five fish per four hours were considered for the Clark Fork sites (at the time of the survey design the predicted improvement in catch rates was unknown for the Clark Fork sites in the baseline, "no-injury" condition). Results for the contingent behavior analysis are reported in Tables 3-3 and 3-4.

Table 3-2
Site Specific Ratings from Mail Survey*
(Q4-Q7)

	Big Hole 2		Rock Creek		Madison 2		UCF 2 and 3		UCF 4		Missouri		Jefferson 2	
	Mean (std. error of mean)	N	Mean (std. error of mean)	N	Mean (std. error of mean)	N	Mean (std. error of mean)	N	Mean (std. error of mean)	N	Mean (std. error of mean)	N	Mean (std. error of mean)	N
Familiarity rating[1] (Q4)	3.21 (0.095)	494	2.93 (0.131)	252	3.21 (0.140)	242	2.35 (0.099)	250	2.00 (0.101)	241	2.82 (0.139)	253	2.43 (0.123)	242
Perception of largest fish[2] (Q5)	5.06 (0.077)	263	4.43 (0.134)	110	5.14 (0.105)	132	4.05 (0.156)	86	4.26 (0.182)	62	5.06 (0.149)	108	4.62 (0.132)	91
Perceived catch rate[2] (Q6)	4.66 (0.085)	264	4.83 (0.136)	107	4.92 (0.117)	134	3.72 (0.139)	85	4.03 (0.193)	68	4.55 (0.149)	107	4.32 (0.154)	92
Rating for nonfishing recreation[2] (Q7)	5.09 (0.094)	238	5.54 (0.123)	111	4.83 (0.123)	133	4.09 (0.133)	95	4.27 (0.195)	66	4.67 (0.140)	95	4.44 (0.153)	85

* Anglers were asked about four of the seven sites. Big Hole 2 appeared on both versions of the mail survey. All other sites only appeared on one version. For this reason, there are more responses for Big Hole 2. The mean ratings for Big Hole 2 do not differ significantly across survey versions.

Ratings:

[1] 1 = *unfamiliar* to 7 = *very familiar*.

[2] 1 = *below average* to 7 = *above average*.

Table 3-3
Results from Contingent Behavior Questions on Mail Survey:
Clark Fork River Sites*
(Q12-Q15)

Changes in Catch Rate per Four Hours Fishing	Clark Fork 2 & 3 Version 1 Mean (standard error of mean) Number of Observations			Clark Fork 4 Version 2 Mean (standard error of mean) Number of Observations		
	+1	+3	+5	+1	+3	+5
Rating of current expected catch (Q6)	3.78 (0.260) N = 19	3.86 (0.295) N = 21	3.45 (0.294) N = 20	4.52 (0.370) N = 19	4.13 (0.467) N = 15	3.79 (0.355) N = 19
Rating of expected catch after change (Q13)	3.68 (0.325) N = 19	4.67 (0.303) N = 21	4.80 (0.427) N = 20	4.21 (0.311) N = 19	5.07 (0.442) N = 15	5.11 (0.366) N = 19
Difference in average number of trips to this site after change (Q14) for:						
All respondents	1.07 (0.253) N = 29	1.31 (0.299) N = 39	2.43 (1.487) N = 40	0.58 (0.151) N = 36	1.64 (0.321) N = 25	1.68 (0.588) N = 34
Those who had positive number of trips to site before change (using Q12 response)	1.57 (0.649) N = 7	2.50 (0.946) N = 10	8.50 (7.368) N = 8	2.00 (0.577) N = 3	3.00 (0.816) N = 7	2.33 (0.558) N = 6
Difference in average number of trips to other sites after change (Q15) for:						
All respondents	-0.27 (0.126) N = 30	-0.11 (0.259) N = 37	-0.24 (0.125) N = 46	0.00 (0.104) N = 31	-0.41 (0.219) N = 29	-0.39 (0.137) N = 31
Those who had positive number of trips to site before change (using Q12 response)	-0.50 (0.327) N = 8	-1.00 (0.681) N = 8	0.10 (0.348) N = 10	0.25 (0.629) N = 4	-0.88 (0.742) N = 8	-0.83 (0.401) N = 6

* Each column represents results from a different subset of respondents.

Ratings: 1 = *below average* to 7 = *above average*.

Table 3-4
Results from Contingent Behavior Questions on Mail Survey:
Big Hole and Madison*
(Q17-Q20)

Changes in Catch Rate per Four Hours Fishing	Big Hole 2 Version 1 Mean (standard error of mean) Number of Observations			Madison 2 Version 2 Mean (standard error of mean) Number of Observations		
	-4	-2	+2	-4	-2	+2
Rating of current expected catch (Q6)	4.86 (0.236) N = 35	4.72 (0.231) N = 36	4.48 (0.227) N = 33	4.80 (0.191) N = 35	5.49 (0.194) N = 35	5.03 (0.221) N = 37
Rating of expected catch after change (Q13)	3.40 (0.253) N = 35	3.42 (0.265) N = 36	5.09 (0.259) N = 33	2.43 (0.214) N = 35	3.91 (0.291) N = 35	5.54 (0.196) N = 37
Difference in average number of trips to this site after change (Q19) for:						
All respondents	-0.42 (0.124) N = 42	-0.38 (0.219) N = 32	0.74 (0.191) N = 34	-0.66 (0.220) N = 41	-0.19 (0.185) N = 37	0.53 (0.141) N = 24
Those who had positive number of trips to site before change (using Q17 response)	-0.48 (0.162) N = 29	-0.65 (0.310) N = 20	0.68 (0.287) N = 19	-0.96 (0.318) N = 25	-0.24 (0.323) N = 21	0.67 (0.187) N = 24
Difference in average number of trips to other sites after change (Q20) for:						
All respondents	0.09 (0.095) N = 47	0.06 (0.091) N = 35	-0.40 (0.141) N = 42	0.74 (0.200) N = 39	0.33 (0.138) N = 36	-0.07 (0.146) N = 41
Those who had positive number of trips to site before change (using Q17 response)	0.04 (0.040) N = 25	0.06 (0.171) N = 18	-0.05 (0.259) N = 18	0.91 (0.286) N = 22	0.53 (0.259) N = 17	-0.23 (0.227) N = 22

* Each column represents results for a different subset of respondents.

Ratings: 1 = *below average* to 7 = *above average*.

Respondents were presented the change in expected catch for trout and then asked to rate the expected catch at the site, which can be compared to their earlier rating of the site in Question 6. Respondents generally rated the site higher if the catch rate increased, and lower if the catch rate decreased.

Respondents also generally indicated they would have taken more trips to a site if the catch rate had increased, and they would have taken fewer visits if the catch rate had decreased. For some respondents, the change in catch rates would not have changed their fishing behavior. For example, respondents who live far from a site might not have taken any additional trips to a site in 1992 if the catch rate had increased at the site. The results vary depending on the site and the change in catch rates that is considered. Overall, for an increase of one to two trout per four hours of fishing, respondents indicated they would have taken one-half to one more trip to the site per year and between zero and 0.4 fewer trips to other sites. This indicates that of the additional trips that would be taken to a site with enhanced catch, some would be new fishing trips and some would be trips substituted from other fishing locations.

Generally, anglers who had previously visited a site in 1992 were more responsive to the proposed change in expected catch at that site than were other anglers. For example, anglers who had visited Clark Fork 2 or 3 in 1992 would increase their trips to the site under the improved catch conditions more than anglers who had not visited the site in 1992. Resident anglers residing close to the site are more likely to have visited the site and are more likely to increase their visits to the site if the catch rates at the site improve.

Target Species and Respondent Comments

In the mail survey (Q11) respondents were asked to identify the fish species they were targeting on a recent trip. Over 74 percent of all anglers indicated they were fishing for trout species, 9 percent had no preference, and 17 percent were fishing for other species. This clearly indicates that trout are the predominate species targeted at southwestern Montana rivers and streams.

The written comments on the mail survey (Q8 and final comments on the survey) also indicate that catch characteristics, and catch rates in particular, are important to anglers. These comments are summarized in Table 3A-5. The largest share of the comments deal with catch limits, catch and release, and stocking of fish.

3.3 OBSERVED CATCH RATES

Each individual intercepted was asked to provide the time he or she began fishing at the intercept site (Q4 on the intercept survey) and the number of trout caught up to that time (Q5

of the intercept survey). Catch data from 1,344 of the intercepted anglers were used in this study.[2]

The amount of catch information collected varies dramatically across sites even though the amount of interview time and number of interviewer site visits were comparable for most of the sites: Madison 2 has catch data for the most trips (172 trips), down to the fewest trips for Little Blackfoot (8 trips). Of the 1,344 trips for which there are catch data, 557 trips (41 percent) were to the five sites with the most trips: Madison 2, Rock Creek, Missouri, Beaverhead, and Madison 1. Only 56 trips were to the five sites with the fewest trips: Little Blackfoot, Upper Clark Fork 4, Warm Springs Creek, Upper Clark Fork 2, and Lolo Creek. In terms of total hours of fishing for which catch is reported, the variation across sites is even more dramatic: 847 hours at Madison versus 7 hours at Warm Springs Creek. There is a total of 2,430 hours of reported catch for Madison 2, Beaverhead, Rock Creek, Yellowstone, and Missouri, but only 112 total hours of reported catch for Warm Springs Creek, Little Blackfoot, Upper Clark Fork 4, Upper Clark Fork 2, and Upper Clark Fork 3.

An important determinant of these disparities across sites is that anglers go to sites that they perceive to have high catch rates and do not go to sites that they perceive to have low catch rates. Madison 2 was given the highest perceived catch rating (Q6 on the mail survey) and Upper Clark Fork 2 and 3 received the lowest rating. This disparity in the number of anglers' trips across sites provides valuable information about expected catch rates because anglers spend less time fishing at sites with low expected catch rates. This information is used in the recreation demand model.

The *simple average* catch rate (total trout catch reported for a site divided by total number of fishing hours reported for a site) is a less reliable estimate of the expected catch rate at sites with few observations on catch. This statistical relationship needs to be, and is, incorporated into the recreation demand model.

3.4 TRIP PATTERNS AND CHARACTERISTICS

The data indicate many factors contribute to where and how often anglers fish. This section describes the trip patterns and trip characteristics of anglers visiting southwestern Montana and the relationships between those trip patterns and angler characteristics. Trip records were compiled from responses to the intercept survey, the telephone survey, and the mail survey.

[2] The catch information from those anglers who had been fishing less than five minutes was not used; it is likely to be unrepresentative. Only 24 of the intercepted anglers with catch data had been fishing for less than five minutes.

The mail survey was completed by 505 anglers, and an additional 8 anglers participated in the telephone follow-up to the mail survey. Thus, we have complete trip records for 513 anglers. Both residents and nonresidents were asked if the primary purpose of the intercept trip was to fish (Q3 on the intercept survey). If the trip was primarily to do something other than fish, data on the intercept trip were omitted from the trip record. If the intercept trip was the only trip in the trip record, the angler was omitted from the data set. Nonresidents were asked if the primary purpose of their most recent trip was to fish (Q34 on the mail survey). If fishing was not the primary purpose, the nonresident angler was dropped completely from the data.[3]

We wanted to retain anglers whose main reason for taking fishing trips was to fish because that is the activity the recreation demand model is designed to explain. However, more joint-purpose trips may be taken if fishing is improved.

By following the above rules about whether a trip was primarily to fish, two percent of resident anglers and one percent of all resident fishing trips were omitted from the data (i.e., the model includes data only on fishing trips, rather than joint purpose trips, for residents). By following these primary purpose rules, 30 percent of nonresidents and 24 percent of nonresident fishing trips were dropped from the data.

The final sample consists of 443 individuals composed of 291 residents and 152 nonresidents. Unless otherwise indicated, the following discussions apply to the final sample of 443 anglers.

Trip Proportions and Determinants of the Total Number of Trips

Our sample took most of their trips in southwestern Montana. Only seven percent of all trips for which trip destination information was reported were taken outside of the four regions depicted in Figure 2-1. For the study sample, approximately 73 percent of all resident trips and 82 percent of all nonresident trips to southwestern Montana were to the 26 intensively studied sites. The six most popular of the 26 intensively studied sites in terms of visitation by the sample are Rock Creek, Bitterroot 2, both Big Hole sites, Missouri, and Madison 2. They account for 52 percent of all the trips to the 26 sites. The five upper Clark Fork sites and Silver Bow Creek account for only six percent of all of the fishing trips to the 26 sites. See Table 3-5 for sample proportions of trips to each of the 26 sites for the full sample, residents, and nonresidents. Note that Beaverhead and Madison 2 are relatively more popular among nonresidents while the Bitterroot sites are more popular among residents.

The data suggest distance to a site explains in part how many trips an angler takes. Nonresidents take far fewer trips than residents, and residents who live farther from the sites take, on average, fewer trips than those who live closer, indicating distance and its

[3] It would have been better to identify which trip in the trip record was associated with Q34. However, it was not always possible to make such an association, so any nonresidents who responded *no* to Q34 on the mail survey were omitted.

Table 3-5
Proportion of Trips to Intensively Studied Sites: May-September 1992

River	Full Sample	Residents	Nonresidents
UCF 1	0.026	0.029	0.006
UCF 2	0.011	0.013	0.000
UCF 3	0.004	0.004	0.000
Middle CF	0.049	0.057	0.000
Rock Cr.	0.065	0.060	0.097
Flint Cr.	0.013	0.013	0.013
Bitterroot 1	0.038	0.044	0.000
Bitterroot 2	0.074	0.081	0.032
Lolo Cr.	0.012	0.014	0.000
Blackfoot	0.026	0.029	0.006
L. Blackfoot	0.017	0.019	0.000
UCF 4	0.007	0.007	0.006
UCF 5	0.015	0.017	0.000
Silver Bow Cr.	0.001	0.001	0.000
WSC	0.003	0.003	0.000
Big Hole 1	0.057	0.058	0.052
Big Hole 2	0.061	0.064	0.045
Jefferson 2	0.038	0.043	0.006
Beaverhead	0.049	0.039	0.116
Jefferson 1	0.017	0.019	0.000
Missouri	0.145	0.149	0.123
Yellowstone	0.038	0.039	0.032
Gallatin	0.040	0.040	0.045
E. Gallatin	0.024	0.026	0.006
Madison 1	0.058	0.064	0.019
Madison 2	0.113	0.069	0.394

relationship to costs play a strong role in determining the number of trips an individual takes.[4]

The data also indicate gender is an important factor in the determination of the total number of trips. Of the 443 members of the final sample, 402 are male. Almost 90 percent of all of the intercepted anglers are male. Males in the sample take, on average, approximately 70 percent more trips than females.

Data on many other variables that characterize the anglers in the sample were collected, including age, wage rate, income, weeks of paid vacation, years fished in Montana, free time on a typical weekday,[5] and self-assessed angler skill rating. The median age for all anglers in the sample is 38. The average hourly wage for residents is $15.67 and for nonresidents is $27.94. The average 1991 pretax income for residents is $41,006 and for nonresidents is $81,672. The wage and income statistics indicate nonresident anglers are on average much wealthier than resident anglers. The average angler has 1.6 weeks of paid vacation per year. The average resident has fished for over 18 years in Montana while the average nonresident has fished for 9 years in Montana. The average angler has almost seven hours of free time on an average summer weekday. On a scale from 1 to 7, with 1 being *novice* and 7 being *expert*, the average angler rates himself around 4.8 (average self-assessed skill ratings do not differ substantially for residents and nonresidents). Average skill level does not vary much across intercept sites; mean skill levels are all in the four to five range on a scale from one to seven. All of these variables proved to be important factors in the participation decision on how often to fish in Montana (see Chapter 5).

Data for anglers in the sample who did not complete the mail survey were not included in the final data set because the trip records for these anglers are incomplete. Little, if any, bias is introduced by excluding anglers in the sample who did not complete the mail survey, as those in the follow-up group who completed the mail survey do not differ substantially from nonrespondents in terms of the total number of trips they take. Respondents took an average of 8.8 trips before they responded to the mail survey while nonrespondents took an average of 7.9 trips before the mail survey.

Trip Duration

Nonresidents spend more time at a site when they come to fish than do residents. Residents spent an average of 4.9 hours on-site during the intercept trip, whereas nonresidents spent an

[4] See Table 3A-6 for statistics on the number of trips taken by sample residents and nonresidents. Due to the intercept nature of the survey, individuals in the sample take, on average, more trips than the average number of trips in the population. This is accounted for in estimation.

[5] Free time is calculated as the hours in a day left after sleeping, working for wages, child care, housekeeping, and studying.

average of 13.1 hours. Also, residents visiting an intercept site closer to their home spend less time on-site than do residents visiting an intercept site farther from their home. Trip duration plays an important role in the determination of trip costs discussed in Chapter 5. Characteristics of trip duration are presented in Table 3-6.

Table 3-6
Trip Duration Characteristics

	Variable	Number of Observations	Mean (standard error of mean)	Mean for Those Who Did Not Visit Another River Site Before Intercept	Mean for Those Who Visited Another Site Before Intercept
Trip Duration Characteristics for Full Sample and by Residence Status					
Full sample	Hours at site	1,848	7.90 (0.289)	6.87	11.03
	Nights on trip	1,853	5.76 (0.315) [median = 1]	3.48	12.46
Nonresident	Hours at site	683	13.05 (0.666)	13.00	13.10
	Nights on trip	697	13.20 (0.711) [median = 8]	10.97	15.50
Resident	Hours at site	1,165	4.88 (0.191)	4.81	5.46
	Nights on trip	1,156	1.28 (0.159) [median = 0]	0.91	4.26
Trip Duration Characteristics for Residents by Distance from Residence					
0-25 miles	Hours at site	589	3.52 (0.096)	3.56	3.09
	Nights on trip	582	0.34 (0.115)	0.34	0.34
26-50 miles	Hours at site	178	6.59 (0.653)	6.24	10.64
	Nights on trip	176	1.66 (0.644)	0.95	11.42
51-150 miles	Hours at site	151	6.13 (0.646)	6.57	4.25
	Nights on trip	150	1.45 (0.178)	1.42	1.59
> 150 miles	Hours at site	70	8.70 (1.482)	8.20	10.73
	Nights on trip	73	3.75 (0.572)	3.31	5.47

Trip Costs

As might be expected, nonresidents report higher expenses for lodging and equipment for the intercept trip than do residents. The average equipment and lodging expenses for nonresidents are $413.67 per trip, whereas for residents they are $25.62 per trip. In general, average intercept-trip lodging and equipment expenses are greater for residents visiting sites farther away from their home than for residents visiting nearby sites. Equipment and lodging expenses are presented in Table 3-7.

Table 3-7
Mean Lodging and Equipment Expenses for Intercept Trip

	Mean Lodging Expense (standard error of mean)	Number of Observations	Mean Equipment Expense (standard error of mean)	Number of Observations
Average Expenses by Residence Status				
Residents	$6.55 (2.102)	976	$19.07 (4.743)	1,169
Nonresidents	$220.89 (20.961)	689	$192.78 (20.747)	701
Average Expenses for Residents by Distance of Residence from Intercept Site				
0-25 miles	$0.12 (0.059)	428	$10.34 (4.630)	592
26-50 miles	$6.29 (5.887)	170	$10.25 (2.109)	178
51-150 miles	$3.44 (1.207)	142	$9.78 (3.006)	150
> 150 miles	$33.49 (11.045)	72	$22.63 (8.775)	72

3.5 SITE CHARACTERISTICS

Destinations and the Sizes of Rivers and Streams

Larger rivers and streams attract more anglers than smaller rivers and streams. A size index for all 26 sites chosen for intensive study was created by multiplying the length of the

segment by the average flow in cubic feet per second (cfs).[6] Flow was not used by itself because length varies greatly over these sites. The shortest site is 2 miles long and the longest is 30 miles long. The largest seven sites account for 42.6 percent of all trips to the 26 intensively studied sites. The smallest seven account for only 13.4 percent.[7] The site sizes are reported in Table 3-8.

Campgrounds

The presence of a campground adjacent to a site might increase or decrease visitation: campgrounds provide on-site accommodations, but some anglers might prefer not to fish near campgrounds. The recreation demand model indicates that campgrounds increase visitation. There are one or more campgrounds directly adjacent to the following sites: Upper Clark Fork 2, Rock Creek, Bitterroot 1, Bitterroot 2, Lolo Creek, Blackfoot, Big Hole 2, Beaverhead, Jefferson 1, Missouri, Gallatin, Madison 1, and Madison 2.[8]

Float Fishing

There are two possible ways to fish a site: from the bank/wading, or by floating the river in a small boat or raft. Sixteen of the 26 intensively studied sites are suitable for effective float fishing: Upper Clark Fork 1, Upper Clark Fork 2, Middle Clark Fork, Rock Creek, Bitterroot 1, Bitterroot 2, Blackfoot, Big Hole 1, Big Hole 2, Jefferson 2, Beaverhead, Jefferson 1, Missouri, Yellowstone, Madison 1, and Madison 2 (D. Workman, S. Leathe, and R. Vincent; MT Dept. of Fish, Wildlife and Parks, pers. comm.). With two exceptions, whether a site is suitable for effective float fishing is completely determined by its size. The two exceptions are the Gallatin and the Beaverhead. Floating is prohibited on the Gallatin; the Beaverhead, while small, is suitable for float fishing because of its relatively slow water and few rocks.

Aesthetics and Other Possibly Relevant Characteristics

We investigate the influence of aesthetics (i.e., scenic quality) on site choice. Aesthetic quality is difficult to quantify because beauty is in the eye of the beholder. While it is possible for significant numbers of individuals to agree that a site is exceptionally ugly or exceptionally attractive, anglers will not all agree on the relative attractiveness of all sites, and they will differ in terms of how they gauge attractiveness. Of the 26 intensively studied sites, Silver

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[6] Because flow data for 1992 were unavailable, average flows from May through August 1991 were used (U.S. DOI, 1991).

[7] See Table 3A-7 for proportions of trips to each site compared to the size of the sites.

[8] Sources: Travel Montana (1995), maps provided by Montana Afloat, 4106 Fox Farm Rd., Missoula MT, 59802, and National Forest Service maps.

Table 3-8
Sizes of 26 Intensively Studied Sites

River	Flow (CFS) Average May-August	Length* (miles)	Size (flow × length)
Middle CF	5,007	25	125,175
Yellowstone	8,333	14	116,662
Bitterroot 1	2,799	25	69,975
Blackfoot	3,397	19	64,543
Missouri	5,479	9	49,311
Jefferson 1	2,459	19	46,721
Jefferson 2	2,459	19	46,721
Madison 2	1,595	29	46,255
Big Hole 1	1,929	21	40,509
Gallatin	1,954	17	33,218
Bitterroot 2	1,487	22	32,714
UCF 1	1,673	19	31,787
Big Hole 2	1,929	13	25,077
Rock Cr.	885	24	21,240
Madison 1	2,024	9	18,216
UCF 2	554	26	14,404
UCF 3	554	19	10,526
Beaverhead	585	12	7,020
UCF 4	228	30	6,840
L. Blackfoot	202	15	3,030
Lolo Cr.	100	24	2,400
Silver Bow Cr.	63	18	1,134
E. Gallatin	160	7	1,120
Flint Cr.	94	10	940
WSC	70	7	490
UCF 5	228	2	456

* Site lengths for all 26 sites were estimated using a map measuring wheel. These lengths can be expected to differ from true river mile lengths because such an instrument cannot capture all river meanders.

Bow Creek is the aesthetic exception; it is ugly. Silver Bow Creek flows into man-made settling ponds with gravel embankments; along its length there is no vegetation, and the soil is barren.

River sites can be accessed either by bank or by floating. Upper Clark Fork 3 is unique in that is has limited bank access and is also not suitable for effective float fishing.[9]

[9] Upper Clark Fork 3, Upper Clark Fork 1, and Yellowstone have limited bank access relative to the other 23 sites (J. Duffield and C. Neher, Bioeconomics, Missoula MT, pers. comm.), but Upper Clark Fork 1 and Yellowstone are suitable for effective float fishing.

CHAPTER 4
A RECREATION DEMAND MODEL THAT ESTIMATES PARTICIPATION, SITE CHOICE, AND EXPECTED CATCH RATES

A recreation demand model based on sound economic and statistical principles was developed that predicts the number of fishing trips (participation) to rivers and streams in Montana. This model also predicts the allocation of those trips among rivers and streams (site choice). Damage estimates are derived from this model.

The model is individual based; it predicts the number of fishing trips and site choices for an individual angler as a function of his or her characteristics and as a function of expected catch rates. Total predicted trips for the sample and population are derived by summing over anglers.

Demand for trips is modeled for all of the rivers and streams in Montana, but not all of the rivers and streams are modeled in the same way. As discussed in Chapters 2 and 3, 26 river sites in southwestern Montana were chosen for intensive study, and specific trip, catch, and site characteristic data were collected for these sites. This group of 26 sites represents a cross section of the rivers and streams in southwestern Montana in terms of size, geographical dispersion, and perceived catch rates. The group includes all of the impacted sites in the Clark Fork River Basin (UCF 1-5 and Silver Bow Creek) and accounts for 73 percent of the river and stream trips to southwestern Montana for residents in our sample and 82 percent for nonresidents in our sample. Montana was divided into five regions: four in southwestern Montana (Missoula, Butte, Helena, and Bozeman), and one for all trips to Montana rivers and streams outside of southwestern Montana. If a trip was not to one of the 26 sites, the trip was modeled as a trip to a collective site designated *other* in the site's region.

The estimated parameters of the model are used to predict what individual trip patterns would be if the expected catch rates for trout in the upper Clark Fork River Basin were at baseline levels. See Chapter 5 for details about estimation and Chapter 7 for details about using the model to predict trip-taking behavior under baseline conditions.

4.1 THE MODEL HAS TWO INTERCONNECTED COMPONENTS: A TRAVEL-COST COMPONENT AND A CATCH RATE COMPONENT

The *travel-cost component* of the recreation demand model predicts where and how often each angler in the sample will fish in southwestern Montana as a function of the expected catch rate at each of 26 sites; other characteristics of the sites such as size, float access, and

campgrounds; the angler's trip costs for each of 26 sites; and other important demographic characteristics of the angler such as age, gender, and residency. Recall that the expected catch rate at a site is what an angler expects a representative angler's catch rate will be on a typical trip to the site. The expected catch rate is not directly observable and must be estimated along with the other parameters in the model.

The *catch rate component* of the model estimates the expected catch rates at the 26 sites as a function of the observations on catch and hours fished at each site, and as a function of how anglers allocate their trips among the sites. If the demand for trips and choice of sites were not a function of expected catch rates, the best estimate of the expected catch rate at each site would be the simple average catch rate for each site. However, demand for trips and sites is a function of expected catch rates. Anglers can be expected to visit sites with higher expected catch rates more often than sites with lower expected catch rates. Therefore, sites with higher expected catch rates have more observations on catch than sites with lower expected catch rates. Because demand for fishing is a function of expected catch rates, observed trip patterns provide significant information with which to predict expected catch rates. The best estimates of expected catch rates are those estimates that jointly best explain observed catch rates and, along with the other explanatory variables, observed trip patterns.

The two components of the model are linked by expected catch rates: trip patterns are a function of expected catch rates, and observed trip patterns provide information that can be used to estimate expected catch rates. Because of this linkage, the two components of the model were jointly estimated. Observed trip patterns and catch data were used to estimate expected catch rates in the catch rate component, and simultaneously, trip patterns were predicted as a function of expected catch rates and other variables such as trip costs in the travel-cost component.

4.2 THE JOINT MODEL OF PARTICIPATION, SITE CHOICE, AND EXPECTED CATCH RATES

The time span of the statistical model is May through September, the period for which trip data were collected. While trips occur in other months, the large majority of trips occur in this period (McFarland, 1989).

Assume the fishing season consists of 60 periods such that in each period an angler takes no more than one fishing trip. There is no stipulation that each period is of equal length; 60 periods were chosen because only ten anglers in our sample (2.2 percent) took more than

60 trips.[1] The individual simultaneously decides both whether to fish at a river or stream in Montana and, if so, which one. Since the angler simultaneously decides both whether and where to fish, it is important to jointly model and estimate participation and site choice. The angler has 31 fishing sites from which to choose: 26 specific sites and 5 *other* sites.[2] In each period, each angler must choose one of 32 alternatives where one of the alternatives is nonparticipation.[3] The angler's choice set for each period is represented by Figure 4-1 (see Table 2-1 for the full names of sites). The sites are grouped by regions that correspond to the major cities in southwestern Montana because anglers are more likely to visit sites near their homes.

This recreation demand model determines the per-period probability that individual i will choose alternative j. The predicted number of trips angler i will take to site j is therefore the per-period probability that individual i will choose site j multiplied by 60, and the predicted number of trips angler i will take to all sites in Montana during the summer season is the sum of his or her predicted trips to the 31 sites.

4.2.1 The Angler's Per-Period Probability of Choosing Alternative j: The Travel-Cost Component

The angler's per-period probability of choosing alternative j is a function of the following variables:

1. *Trip costs for each of the sites.* The number of trips an individual takes is a decreasing function of the relative cost of fishing trips; i.e., as fishing becomes more expensive, everything else constant, the angler will take fewer trips. In addition, given the decision to take a trip, the choice of sites depends on the relative costs of trips to the different sites; i.e., sites with low trip costs are visited more often than sites with high trip costs.

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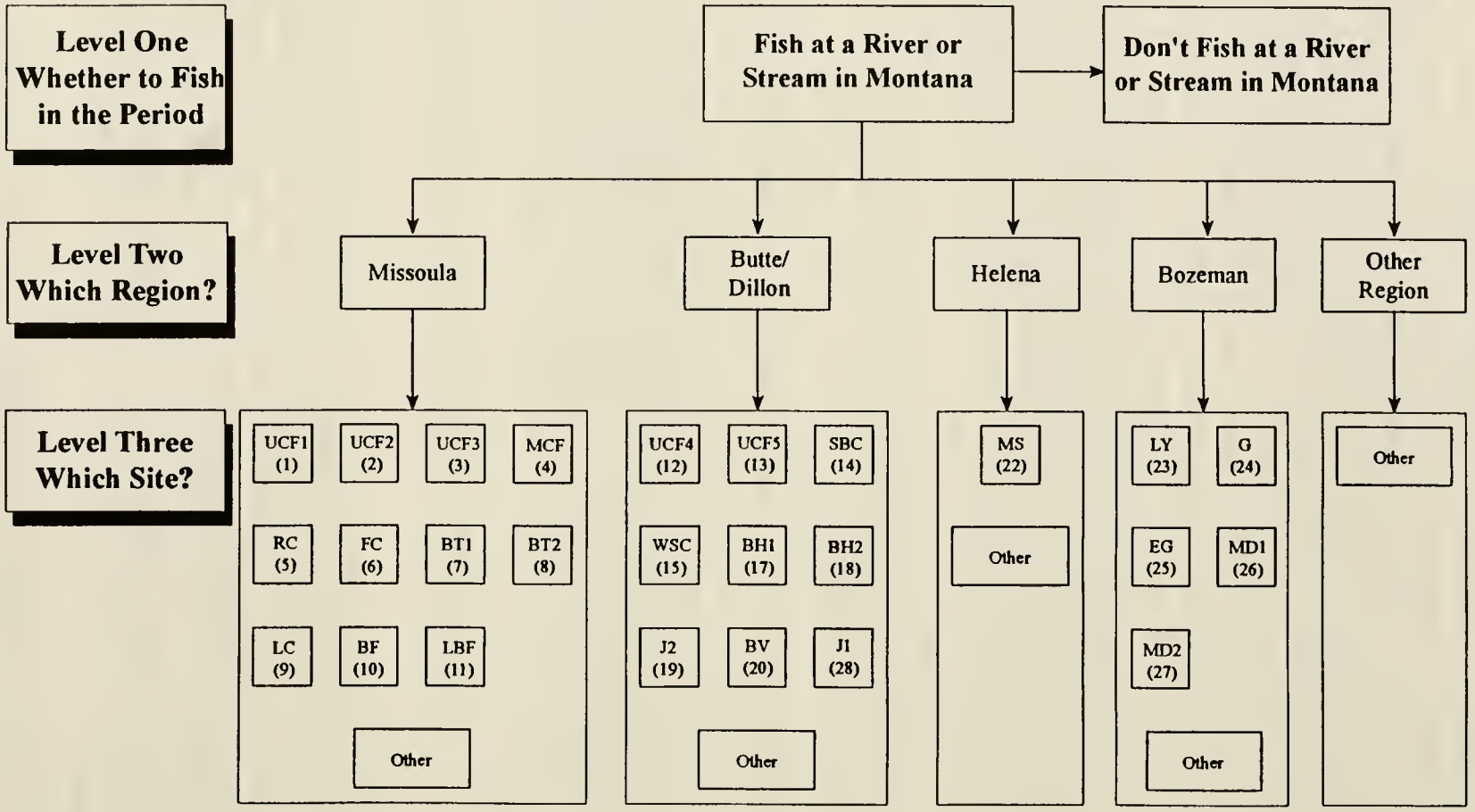
[1] The assumption that the season can be modeled as consisting of N periods where in each period an angler can take at most one trip is a simplifying assumption adopted from Morey et al. (1991) and Morey et al. (1993). While the assumption is not literally true, it is a proven modeling device for predicting total trips and site choices. Note that truncating the maximum number of trips to 60 will cause the estimates of both total trips and damages to be biased downward.

[2] The five *other* sites are composed of one *other* site for each of the four regions in southwestern Montana, and a fifth *other* "catch-all" site for all trips to Montana rivers and streams outside of southwestern Montana.

[3] Nonparticipation includes fishing at sites, such as lakes, that are not rivers or streams.

Figure 4-1
Each Angler's Choice Set for Each Period*



* Numbers in parentheses correspond to site numbers in Table 2-1.

2. *The expected catch rates at each of the sites.* The expected catch rates affect demand in two ways: with higher expected catch rates, anglers will take more trips overall, and anglers visit sites with higher expected catch rates more often than sites with lower expected catch rates.

3. *The size of the fishing sites.* With everything else constant, anglers will take more trips to large sites than to small sites.[4]

4. *Other site characteristics.* These include campgrounds and float access.[5]

In addition, an angler's participation rate and/or site choice is a function of the following seven demographic characteristics of the angler: gender, age, reported fishing skill, years fished in Montana, weeks of paid vacation, reported free time for a typical weekday, and whether the angler is a resident of Montana. The detailed recreation demand model is described in Appendix 4A.

4.2.2 The Catch Rate Component

This component of the model assumes the probability that a representative angler will catch x fish at a site depends on the expected catch rate for that site and the number of hours fished, and is increasing in both. The expected catch rates for the 26 intensively studied sites are unobservable and must be estimated.

The intent of this component of the model is to derive the best estimate of each site's expected catch rate. Two different types of information were collected that can be used to derive best statistical estimates of the expected catch rates:

Number of fish caught and hours fished were recorded for each angler intercepted. One estimate of a site's expected catch rate, but not the best estimate, is the total of the reported catch at the site divided by the hours of fishing for which catch was reported. Denote this estimate as the *simple average*.

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[4] A site's size is defined as the site's average flow from May through August (in cfs) multiplied by the site's length (in miles — see Table 3-8). Sizes of the sites are important determinants of both the total number of fishing trips to southwestern Montana and which sites are chosen because, everything else constant, larger sites have more access points and more places to fish.

[5] A parameter for sites that are exceptionally unattractive (only Silver Bow Creek) and a parameter for sites with both bad bank access and that are unsuitable for effective float fishing (only Upper Clark Fork 3) were both found to be insignificant determinants of participation and site choice.

The simple average is not the best estimate of the expected catch rate because total fishing time and the number of observations on catch are positively related to the expected catch at the site. Sites with high perceived catch rates will have many observations on catch and sites with low perceived catch will have only a few observations on catch, even though approximately the same amount of time was spent interviewing at each of the 26 intensively studied sites (except Silver Bow Creek which received about 48 percent of the interviewing time received by other sites; see Duffield et al., 1992a). The number of observations on catch varies from 0 at Silver Bow Creek to 176 at Madison 2, and the reported fishing time for which we have catch data varies from 7 hours at Warm Springs Creek to 847 hours at Madison 2.

The simple average for a site with few hours of reported catch will be an imprecise estimate of the site's expected catch rate relative to sites with many hours of reported catch. For example, the simple average for Upper Clark Fork 4, 1.5 fish per hour (based on 21 hours of reported catch from 9 trips) is a very imprecise estimate of the site's expected catch rate, whereas the simple average for Madison 2, 0.72 (based on 847 hours of reported catch from 172 trips) is a relatively precise estimate of the expected catch rate at Madison 2.[6] Therefore, assuming the expected catch rates are the simple averages is not the best way to proceed. Fortunately, there is additional information.

Trip patterns were recorded for all of the anglers followed up, and observed trip patterns can be used to provide additional information to estimate expected catch rates. As noted above, anglers take more trips to sites with higher expected catch rates and fewer trips to sites with lower expected catch rates. If one had data on catch and hours fished but no data on trip patterns, the best statistical estimate of a site's expected catch rate would be the total of the reported catch at the site divided by the total of reported hours fishing (the simple average). Alternatively, if one had data on trip patterns but no data on individual catch rates, the best statistical estimates of expected catch rates would be those estimates that, along with trip costs, site sizes, and demographic variables, best explain the collective trip patterns of all anglers in the sample.

Since data are available on both individual observed catch and individual trip patterns, the best statistical estimate of a site's expected catch rate is a weighted average of these two separate estimates, where the weight on a site's simple average observed catch rate is an increasing function of the number of hours of fishing at the site for which catch is reported. Such a weighting is critical because if the average of a site's observed catch rates is based on a large number of observations (a popular site), the simple average observed catch rate is likely to be a good estimate of the site's expected catch rate, but the simple average observed

[6] When the number of observations is small, the simple average is often unduly influenced by a few extreme observations. For example, one of the individuals intercepted at Upper Clark Fork 4 reported catching 18 fish in three hours. Eliminating this one observation drops the simple average from 1.5 to 0.77 fish per hour.

catch rate is less likely to provide a good estimate of a site's expected catch rate if it is only based on a few observations.

4.3 USE OF THE RECREATION DEMAND MODEL

Chapter 5 presents the estimated recreation demand model and discusses the model's ability to explain observed trip patterns. The model can predict how many trips an angler will take and to where as a function of any set of expected catch rates. Expected catch rates for the baseline scenario are presented in Chapter 6. The model is used in Chapter 7 to predict how many trips would have been taken and to where, during 1992, if there had been no injuries to the Clark Fork River Basin. This is accomplished by replacing expected catch rates at the impacted sites with the expected catch rates that would have existed if there had been no injuries.

Chapter 5
Implementation and Estimation of the Recreation Demand Model of Participation, Site Choice, and Expected Catch Rates

5.1 Empirical Implementation of the Recreation Demand Model

The sample of anglers used in the recreation demand model is composed of 443 residents and nonresidents for whom we have trip records for the entire 1992 summer season (see Section 3.4). The sample is composed of licensed anglers from cities and towns widely distributed over Montana, the rest of the United States, and Canada.

The Cost of a Trip to Site j for Individual i

This section describes the construction of trip cost to each site.

The recreation demand model requires not only trip records for each individual in the sample but also data on the characteristics of each angler, data on trip costs to each site for each individual, and data on site characteristics. The cost of a trip to site j has four components: transportation costs, lodging costs, equipment costs, and the opportunity cost of the individual's time in travel and while at the site. For a given individual, trip costs vary across sites as a function of the distance of the sites from the angler's residence. For a given site, trip costs vary across individuals as a function of how far they reside from the site and the opportunity cost of their time. Using several assumptions, which are described below, trip costs to each of the 26 intensively studied sites were calculated for each of the 443 individuals.

The relevant cost of a trip to site j by individual i in the recreation demand model is not his or her reported trip expenses on a past trip to site j (anglers do not visit all sites), but is instead the expected cost to visit the site. The amount an angler would be expected to spend on a typical trip to site j depends on that angler's characteristics. Trip cost is determined by the distance to the site, the angler's wage rate, average equipment and lodging costs by one-way distance category (0-25 miles, 26-50 miles, 51-150 miles, and more than 150 miles), and average on-site time by distance category. Distance and per-mile vehicle operating costs were used to determine transportation costs for residents and all nonresidents for whom driving was less expensive than flying, and airfares and car rental rates were used to calculate transportation costs for distant nonresidents. See Appendix 5A for further details on the calculation of trip costs.

For residents, the sum of a trip's expected direct money costs for transportation, lodging, and equipment ranges from $10.52 for a trip to Silver Bow Creek by a resident of Butte to $176.30 for a trip to Bitterroot 2 by an individual who lives in Billings. For nonresidents, the sum of a trip's direct money costs for transportation, lodging, and equipment ranges from $471.42 to $941.17. Trip time, which includes round trip travel time and on-site time, varies from about three and a half hours for a trip to Silver Bow Creek from Butte to around 66 hours for an automobile trip from New Mexico to Bitterroot 2. On-site time was assumed to be the average reported on-site time by distance category. For example, the average on-site time for sites between 51 and 150 miles of a resident's home is about six hours. The amount of time an individual spends at a site is an increasing function of the distance to the site (see Table 3-6).

Table 5-1 uses an angler from Butte to demonstrate how trip time and money costs increase with distance for six sites ordered by distance from Butte: Upper Clark Fork 5, Jefferson 2, Upper Clark Fork 2, Madison 2, Missouri, and Bitterroot 2.

Table 5-1
Money Costs (lodging, equipment, and transportation costs) and Trip Time for a Resident of Butte

River	Money Cost	Trip Time* (hours)	One-Way Distance (miles)	River	Money Cost	Trip Time* (hours)	One-Way Distance (miles)
UCF 5	$15.96	4.41	20	Madison 2	$37.97	10.13	90
Jefferson 2	$17.34	4.63	25	Missouri	$39.07	10.31	94
UCF 2	$31.37	9.06	66	Bitterroot 2	$44.57	11.20	114

* Trip time includes round trip travel time and on-site time.

Time costs are converted to money costs by multiplying travel and on-site time by the opportunity cost of the individual's free time as estimated by the recreation demand model. That is, the opportunity cost of the individual's free time was allowed to be that fraction of the wage rate that, along with the other parameters in the model, best explains participation and site choice. Each individual could have added more hours at his or her current job or substituted a part-time job for his or her free time, so one of the costs of a trip is the opportunity cost of the individual's time. The per-hour opportunity cost of the individual's free time is assumed to be some fraction, β_W, of the individual's wage rate, which was estimated by the recreation demand model. The value estimated by the recreation demand

model of β_W is 0.11. Estimating the fraction B_W is preferred to forcing the fraction to take the value from some other study or model.[1] The fraction 0.11 is lower than most values from the travel cost literature (see, for example, Smith, Desvousges, and McGivney, 1983; McConnell and Strand, 1981; Smith et al., 1983; and Bockstael et al., 1987b).

Other angler characteristics included in the recreation demand model are gender, residence status, amount of free time on a typical weekday, self-assessed skill level, weeks of paid vacation in a year, years fished in Montana, and age. All of these data were collected by the intercept and mail surveys and are discussed in Chapter 3.[2]

Data on site size, presence of campgrounds, access, aesthetics, and the individual catch observations are also inputs into the model. These data are discussed in Chapter 3.

5.2 ESTIMATION OF THE TRAVEL-COST AND CATCH RATE COMPONENTS OF THE RECREATION DEMAND MODEL

Statistical estimation of the model required finding those values of the model's parameters that simultaneously best explain the number of fishing trips, site choices, and observed catch (the likelihood function and other details are provided in Appendix 5B). There are 47 parameters in the model, including 25 expected catch rates; 3 parameters that determine the influence of expected catch; 3 parameters that determine the influence of trip costs; a parameter that determines the influence of site size; 2 parameters that, along with the parameter on site size, determine the influence of whether a site is suitable for float fishing; a parameter that determines the influence of campgrounds; 7 other parameters that explain the influence of residency, gender, skill level, free time, years fished in Montana, vacation, and age; plus 5 other parameters. A site-specific parameter that allowed Silver Bow Creek to be unique (Silver Bow Creek is ugly) did not add to the model's ability to explain participation and site choice, and therefore it was eliminated from the model. For the same reason, a site-specific parameter that allowed Upper Clark Fork 3 to be unique (it has limited bank access and is unsuitable for float fishing) was tested and eliminated. The statistical computer package *Gaussi* was used to estimate the parameters that maximize the likelihood that the trip patterns and catch (observed in the actual data) were generated by the estimated recreation demand model. The resulting parameter estimates are called maximum likelihood estimates.[3]

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[1] Therefore, 0.11 should not be used in some other travel cost model.

[2] Missing values for the variables were substituted with averages by gender or resident groupings so that values are present for all variables for all 443 anglers. Eighty-four percent of anglers have no missing values.

[3] The model was estimated a number of times by adding parameters in different sequences; each time the model generated the same parameter estimates. Default settings were utilized.

Due to the intercept nature of the sampling, the 443 individuals in the data set take, on average, more trips than would anglers randomly chosen from the population of anglers who fish rivers and streams in Montana.[4] This fact has implications for the estimation because one choice in the choice set is "not fishing at a river or stream," and this alternative is chosen more often in the population than it is in the sample. To adjust for this, choice-based weights were used (Manski and Lerman, 1977). The observed choices (fishing or nonfishing) were weighted, separately for residents and nonresidents, by the ratio of the population probability of the choice to the sample probability of the choice. Details are provided in Appendix 5B.

The coefficient estimates for the recreation demand model are in Table 5C-1 in Appendix 5C. The estimated influence of modeled variables on the predicted number of trips and predicted site choices can be summarized as follows. Anglers who face higher trip costs take fewer trips, and when they do take a trip, everything else constant, they prefer sites with relatively low trip costs. Comparing residents and nonresidents, while the number of trips and site choices for both groups is significantly influenced by trip costs, the influence is less, in absolute terms, for nonresidents. This is as expected and is consistent with the fact that nonresidents fish in Montana even though trip costs for a nonresident are, on average, more than ten-fold the average trip costs for a resident.

Trip costs are only one of the explanatory variables. Anglers take more trips to sites with high catch rates than to sites with low catch rates. In addition, an increase in expected catch rates would cause an angler to increase his or her total number of trips. Finally, expected catch rates are more important to nonresidents than residents.

Everything else constant, anglers prefer larger sites to smaller sites, prefer sites with campgrounds, and prefer sites that are suitable for float fishing. Males take significantly more trips than females, and not surprisingly, residents fish more often in Montana than nonresidents. The number of trips an angler takes is an increasing function of his or her self-assessed skill level and reported hours of free time in a typical summer weekday. The number of trips an angler takes is a decreasing function of his or her age, years fished in Montana, and weeks of paid vacation.

[4] This does not affect the sample site proportions. Sample site proportions calculated after weighting each individual's trips by the number of trips he or she took are almost identical to the unweighted site proportions (their correlation coefficient is 0.99).

5.3 FISHING TRIPS AND TRIP PATTERNS

5.3.1 Actual and Estimated Number of Fishing Trips to Rivers and Streams in Montana and Site Choices

One important gauge of how well the estimated model explains the trip patterns for the population is to compare the mean of the population number of trips estimated using data from the 1991 National Survey with the mean of the number of trips predicted by the model. The predicted number of trips was derived from the estimated model using the site sizes, expected catch rates and other site characteristics; and the angler's trip costs, age, gender, skill, free time, residency, years fished in Montana, and weeks of paid vacation. The 1991 National Survey estimate of the average number of trips taken annually by residents to rivers and streams in Montana is 8.8, and the average predicted number of trips for this study for 1992 is 9.4. Both estimates of the average number of trips per year for nonresidents is 1.4. These results indicate the estimated model is accurately predicting the actual number of trips.[5]

Multiplying 9.4 and 1.4 by the number of resident and nonresident anglers active in river fishing in southwestern Montana, we estimate 669,252 trips to Montana rivers and streams by residents in 1992, and 92,340 by nonresidents. These totals are similar to the figures estimated using data from the 1991 National Survey: 628,855 resident trips and 92,295 nonresident trips to rivers and streams in Montana.

The model predicts that 94 percent of resident trips and 92 percent of nonresident trips will be to southwestern Montana, which implies 625,213 total trips by residents and 84,130 trips by nonresidents annually in 1992 to rivers and streams in southwestern Montana.[6] In comparison, annual Montana Department of Fish, Wildlife, and Parks (MDFWP) salmonid stream pressure estimates for southwestern Montana from the 1980s are 567,826 angler days

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[5] The model predictions are for the summer season. As reported in Appendix 3B, 72 percent of resident salmonid stream fishing pressure and 95 percent of nonresident pressure in southwestern Montana occur during the summer. Annual estimates of the number of trips are derived by dividing summer figures by these percentages. Damage estimates for the year are similarly derived.

[6] For residents, the calculation is: 71,239 anglers active in the region × 9.39 trips on average × 94 percent of all trips predicted by the recreation demand model to be in southwestern Montana = 625,213 total trips.

For nonresidents, the calculation is: 65,313 anglers active in the region × 1.41 trips on average × 92 percent of all trips predicted by the recreation demand model to be in southwestern Montana = 84,130 total trips.

for residents and 265,844 angler days for nonresidents (McFarland, 1989; McFarland, 1992).[7] If we assume that residents spend one day per trip and nonresidents spend 3.49 days per trip,[8] the MDFWP 1980s annual trip estimates are 567,826 trips for residents and 76,216 trips for nonresidents, which summed are 9 percent lower than our total 1992 estimate.

Further, our estimate of the current total number of trips to the six impacted sites in the upper Clark Fork River Basin is only slightly larger than Hagmann's estimate of use on the Clark Fork River and Silver Bow Creek in 1978. Adjusting for trips to tributaries of the Clark Fork River, Hagmann (1979) estimates approximately 36,500 total visits to our six impacted sites during the year. We can use our model's results to estimate for 1992 there were 37,987 resident trips and 4,383 nonresident trips to the six impacted sites under current conditions.[9]

Another important gauge of how well the estimated model explains observed behavior is to compare the actual observed sample site proportions for the 26 intensively studied sites with the predicted site proportions. The correlations between the actual and predicted site proportions are high, reflecting high predictive power in the model. The correlation coefficients are 0.71 for the full sample, 0.70 for residents, and 0.67 for nonresidents.

5.3.2 The Responsiveness of Trip Demand to Changes in Trip Costs

Demand for fishing trips changes with changes in the determinants of demand such as expected catch rates and trip costs (or "prices"). Measures of demand responsiveness to such changes are typically reported in percentage terms to make them independent of the units in which demand and its determinants are measured. The percentage change in the demand for trips caused by a one percent change in trip costs, holding other variables constant, is called the *elasticity* of trip demand with respect to cost. A response is deemed elastic (inelastic) if

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[7] These pressure estimates are five-year averages (1982 through 1985 and 1989) for the total number of salmonid and undesignated river and stream angler days for Regions 2 and 3 scaled up by 25 percent to account for the portions of Regions 1 and 4 that are part of southwestern Montana. These averages may be low because of downwardly biased use estimates from 1984 (R. McFarland, Montana Department of Fish, Wildlife, and Parks, pers. comm.).

[8] We use existing data and recreation demand model results to estimate the number of days per nonresident angler trip. 3.49 days per nonresident trip = (265,844 total nonresident days/58,932 nonresident anglers)/(1.41 trips per nonresident angler × 92 percent). 58,932 nonresident anglers is a five-year average over 1982 through 1985 and 1989, the same years of the pressure data. Ninety-two percent is the predicted proportion of nonresident trips that are within southwestern Montana.

[9] For residents, the calculation is: 71,239 anglers in our region × 0.53 trips on average to the six sites = 37,987 trips.

For nonresidents, the calculation is: 65,313 anglers in our region × 0.07 trips on average to the six sites = 4,383 trips.

the percentage decrease in trips taken is greater than (less than) the percentage increase in trip costs.

In Tables 5-2 and 5-3 we report the price elasticities of demand for the group of impacted sites and for the group of 26 intensively studied sites. These estimated elasticities are consistent with expectations based on economic theory.

Table 5-2
Decreases in Demand for Fishing Trips to the 26 Sites
Resulting from Increases in Trip Costs to the 26 Sites

Increase in Costs for 26 Sites	Decrease in Trips to 26 Sites	
	Residents	Nonresidents
1%	-0.8%	-1.4%
10%	-7.5%	-14.5%
100%	-57.8%	-92.5%

Table 5-3
Decreases in Demand for Fishing Trips to the Impacted Sites
Resulting from Increases in Trip Costs to the Impacted Sites

Increase in Costs for Impacted Sites	Decrease in Trips to Impacted Sites	
	Residents	Nonresidents
1%	-2.2%	-4.1%
10%	-19.3%	-33.9%
100%	-84.1%	-97.9%

Everything else constant, the more substitutable a commodity, the higher is its price elasticity. That is, if there are many substitutes for a commodity it is easier to replace it with one of those substitutes if its price increases. In general, but not always, the more broad the category of commodities the fewer substitutes the category will have, and the lower the price elasticity will be.

For the population for which we estimated damages, anglers who actively fish the rivers and streams of southwestern Montana, individual fishing sites, or small groups of sites (e.g., the

impacted sites), are expected to have closer substitutes (other sites or regions) than fishing in general, and our elasticity estimates demonstrate this. For example, assume in one scenario that trip costs to a single fishing site in southwestern Montana increase by one percent. Then assume in a second scenario that trip costs to all sites in southwestern Montana increase by one percent. Because the possibilities for substitution for an individual site are much greater than the possibilities for substitution for all sites (the angler would either have to travel to another part of Montana or another state, or not fish rivers at all), we would expect the price elasticity of demand for trips to the single site to be much greater than the price elasticity for all of southwestern Montana, and this is what our elasticity estimates indicate. Generally, our analysis confirms that it is important to anglers that they fish in southwestern Montana, i.e., activities such as bowling, stream fishing outside of southwestern Montana, or lake fishing do not easily substitute for fishing at a river or stream in southwestern Montana, but changes in costs and/or expected catch rates can result in significant substitutions across sites.

Changes in trips are estimated for 1, 10, and 100 percent increases in trip costs.[10] We report elasticities for these three levels of change because the relationship is not linear. Table 5-2 shows how the same percentage increase in the trip costs to all 26 sites causes the total demand for trips to those sites to decrease. The change in demand for residents is inelastic, whereas the demand for nonresidents is elastic for at least a 10 percent increase in costs. This comparison indicates that in percentage terms, nonresidents are more responsive to cost changes than residents, even though residents are more responsive than nonresidents to an absolute dollar increase in costs. This is not surprising given that an equivalent percentage change in costs for residents and nonresidents corresponds to a much greater absolute change for nonresidents. Note that a doubling of costs significantly decreases, but does not eliminate, demand by residents; however, a doubling of costs does drive nonresident demand to close to zero.

Table 5-3 reports elasticities for the case where trip costs at only the six impacted sites are all increased simultaneously. Both resident and nonresident demand are price elastic for cost increases at least up to 10 percent. As expected, the elasticities for the smaller group of impacted sites are greater than the elasticities for the entire group of 26 sites because there are more substitutes for the small group of impacted sites than for the large group. As noted earlier, this result reflects standard economic expectations.

5.4 ESTIMATED EXPECTED CATCH RATES

The model's estimated expected catch rates for the 26 intensively studied sites are reported in Table 5-4 where they are ranked from highest to lowest. The top five sites include some of

[10] From this point forth, we generally define the term elasticity as the percent change in trips divided by the percent change in trip costs, where the change in trip costs is 1, 10, or 100 percent.

Table 5-4
Estimated Expected Catch Rates
(trout per hour fishing)

River	Expected Catch Rate	River	Expected Catch Rate
E. Gallatin	1.0510	Lolo Cr.	0.6826
Rock Cr.	0.9262	Beaverhead	0.6366
Big Hole 1	0.8985	Middle CF	0.4465
Gallatin	0.8842	UCF 1	0.4340
Flint Cr.	0.8767	UCF 3	0.4233
UCF 4	0.8455	Madison 1	0.4128
Big Hole 2	0.8116	Yellowstone	0.3817
UCF 5	0.7838	Jefferson 2	0.3259
WSC	0.7707	Jefferson 1	0.2801
Missouri	0.7604	Blackfoot	0.2672
Bitterroot 2	0.7391	Bitterroot 1	0.2398
L. Blackfoot	0.7309	UCF 2	0.2217
Madison 2	0.7260	Silver Bow Cr.	0.0000

the most famous trout steams in the United States. In contrast, four of the ten sites with the lowest expected catch rates are impacted sites in the upper Clark Fork River Basin (UCF 1, 2, and 3, and Silver Bow Creek). While some experienced anglers might find these 26 estimated expected catch rates to be lower than he or she might have imagined, one must remember that a proportion of anglers have many hours when they catch no fish. In our sample, for example, almost 50 percent of the anglers reported zero catch.

There is a strong correlation between the *simple average* catch rates and the estimated expected catch rates from the model (recall from Section 4.2.2 that the simple average catch rate is the total of the reported catch divided by the hours of fishing for which catch was reported). The correlation is 0.79. If the data are weighted by the number of hours fishing at each site, the correlation is 0.99. If only the 21 most-fished sites are considered (accounting for over 98 percent of the hours fished in the sample), the correlation is 0.92 (the correlation of the simple and estimated catch rates for the three least-fished sites is only 0.53).

While the mean of the simple average catch rates is only a little higher than the mean of the estimated expected catch rates from the model (0.74 versus 0.62), for the three least-fished rivers and streams, the mean of the simple average catch rate is almost twice the mean of the model-estimated expected catch rates. For these three sites, the mean of the simple average catch rates is 1.4, while the mean of the model-estimated expected catch rates for these three sites was only 0.78. This demonstrates that the model is performing correctly: if the mean expected catch rate at the three least-fished sites were truly 1.4 (compared to the sample average of 0.74), the sites would be much more heavily fished. It is clear that for a few less-fished sites, a small number of anglers reported unusually high catch, which disproportionately influences the simple average. Recall the example in Section 4.2.2 where the elimination of one angler at the Upper Clark Fork 4 site drops the simple average from 1.5 to 0.8 fish per hour. By explicitly considering trip frequency, the two-component model does a superior job estimating expected catch rates because the simple averages for sites with only a few hours of reported catch will be imprecise estimates of the expected catch rates.

There is also a strong correlation between the estimated expected catch rates and the angler's rating of the sites in terms of perceived catch. On the mail survey, anglers rated seven sites on a scale from one to seven in terms of perceived catch.[11] The correlation coefficient between estimated and perceived expected catch rates is 0.60, indicating that anglers' perceptions of expected catch rates are highly correlated with the estimated expected catch rates.

There is also a strong correlation between the estimated catch rates and estimates of the fish stocks. The relationship between stocks and expected catch rates is demonstrated and discussed in Chapter 6. This correlation lends further support to the reliability of our estimates of the expected catch rates. Chapter 6 also provides estimates of what expected catch rates would be if there were no injuries to the upper Clark Fork River and Silver Bow Creek, i.e., the baseline expected catch rates. The extent of the damages is not determined by whether a site currently has a high or low expected catch rate, but by the magnitudes of the injury-induced reductions in expected catch rates. A site that is currently good might have been even better.

[11] Question 6 on Version 1 of the mail survey rates Big Hole 2, Rock Creek, combined Upper Clark Fork 2 and 3, and Missouri in terms of perceived catch. Version 2 rates Big Hole 2, Madison 2, Upper Clark Fork 4, and Jefferson 2 in terms of perceived catch (see Table 3-2).

CHAPTER 6
THE RELATIONSHIP BETWEEN TROUT STOCKS AND EXPECTED CATCH RATES: THE STOCK/HARVEST MODEL

A *stock/harvest* model was developed to investigate the relationship between trout stocks and expected catch rates. This model was estimated using current stock estimates and the estimated current expected catch rates. The stock/harvest model and our estimates of baseline (no-injury) stocks were then used to predict baseline expected catch rates at the injured sites under baseline conditions. Frequently in the literature, baseline expected catch rates are estimated based on the assumption that if stocks would double in the absence of injuries, then expected catch rates would also double (assuming a 1:1 ratio). Compared to this assumption, our stock/harvest model yields more conservative estimates of the increases in expected catch rates at the impacted sites for the baseline scenario.

6.1 THE STOCK/HARVEST MODEL

Trout stock estimates, which are measured in number of trout per hectare (10,000 square meters), were calculated using 1991 trout stock data collected for eight of our sites (Don Chapman Consultants, 1995). The data were collected by snorkeling and include brook, brown, and rainbow trout. Trout sampling data are available for 8 of the 26 sites in the recreation demand model: the five upper Clark Fork River sites, Silver Bow Creek, Rock Creek, and Big Hole 1.

For each of these eight sites, stock data were collected for multiple stretches. To obtain average mile-weighted stock estimates, the stocks for each stretch were multiplied by the length of the stretch in river miles. These values were summed over each of the sites in this study and divided by total river miles to yield a mile-weighted average stock.[1] The 1991 average mile-weighted stock estimates for the eight sites are reported in Table 6-1.

Our stock estimates range from zero fish per hectare at Silver Bow Creek to 583.7 fish per hectare at Upper Clark Fork 5. Note the variation among stocks at Clark Fork sites. The stock at Upper Clark Fork 5 is over 80 times larger than the stock at Upper Clark Fork 2.

[1] When stock estimates were not available for all of the lengths in a site, we assumed the mile-weighted average for the site is the weighted average of the lengths for which there are stock estimates. For the majority of the sites, stock estimates are available for over 92 percent of the total lengths. The data from Don Chapman Consultants (1995) used for calculating average mile-weighted stocks are presented in Appendix 6A.

Table 6-1
1991 Stock Estimates in Trout per Hectare

River	Stock	River	Stock	River	Stock
UCF 1	63.82	UCF 4	119.98	Rock Cr.	206.22
UCF 2	7.14	UCF 5	583.70	Big Hole 1	38.02
UCF 3	13.78	Silver Bow Cr.	0.00		

There exists a strong relationship between estimated expected catch rates and stocks. The following regression equation was used to relate the estimated catch rates to estimated stocks:

$$ECR_j = \phi \ \ell n \ (STOCK_j + 1) + \varpi_j$$

where:

ECR_j = expected catch rate (trout caught per hour) at site j from the recreation demand model

$STOCK_j$ = 1991 stock estimate (average mile-weighted trout per hectare) at site j calculated using data from Don Chapman Consultants (1995)

ϖ_j = random error in observation j.

The functional form of the regression allows for a nonlinear stock-harvest relationship (which provided a better statistical fit to the data than did a linear model), and implies zero expected catch where stocks are zero.[2] The data used to estimate the model are in Table 6-2. The regression results are provided in Table 6-3. This model explains 93 percent of the variation in estimated expected catch rates and is highly statistically significant. Figure 6-1 illustrates the relationship between estimated expected catch rates and stocks for the eight sites used in the analysis.

Overall, the model demonstrates a highly statistically significant relationship between the estimated stocks and estimated expected catch rates. Therefore, this model provides a strong basis for computing expected catch rates under baseline conditions at the impacted sites.

[2] The model was also estimated including an intercept term, which was, as anticipated, not statistically significantly different from zero.

Table 6-2
Stock/Harvest Model Data and Predicted Values of Expected Catch Rates (per hour)

River	Average Mile-Weighted Stock (all trout/hectare)	Recreation Demand Model Estimates of Expected Catch Rates*	Stock/Harvest Model Predictions of Expected Catch Rates
UCF 1	63.82	0.434	0.642
UCF 2	7.14	0.227	0.323
UCF 3	13.78	0.423	0.414
UCF 4	119.98	0.846	0.738
UCF 5	583.70	0.784	0.980
Silver Bow Cr.	0.00	0.000	0.000
Rock Creek	206.22	0.926	0.821
Big Hole 1	38.02	0.899	0.564

* See Table 5-5.

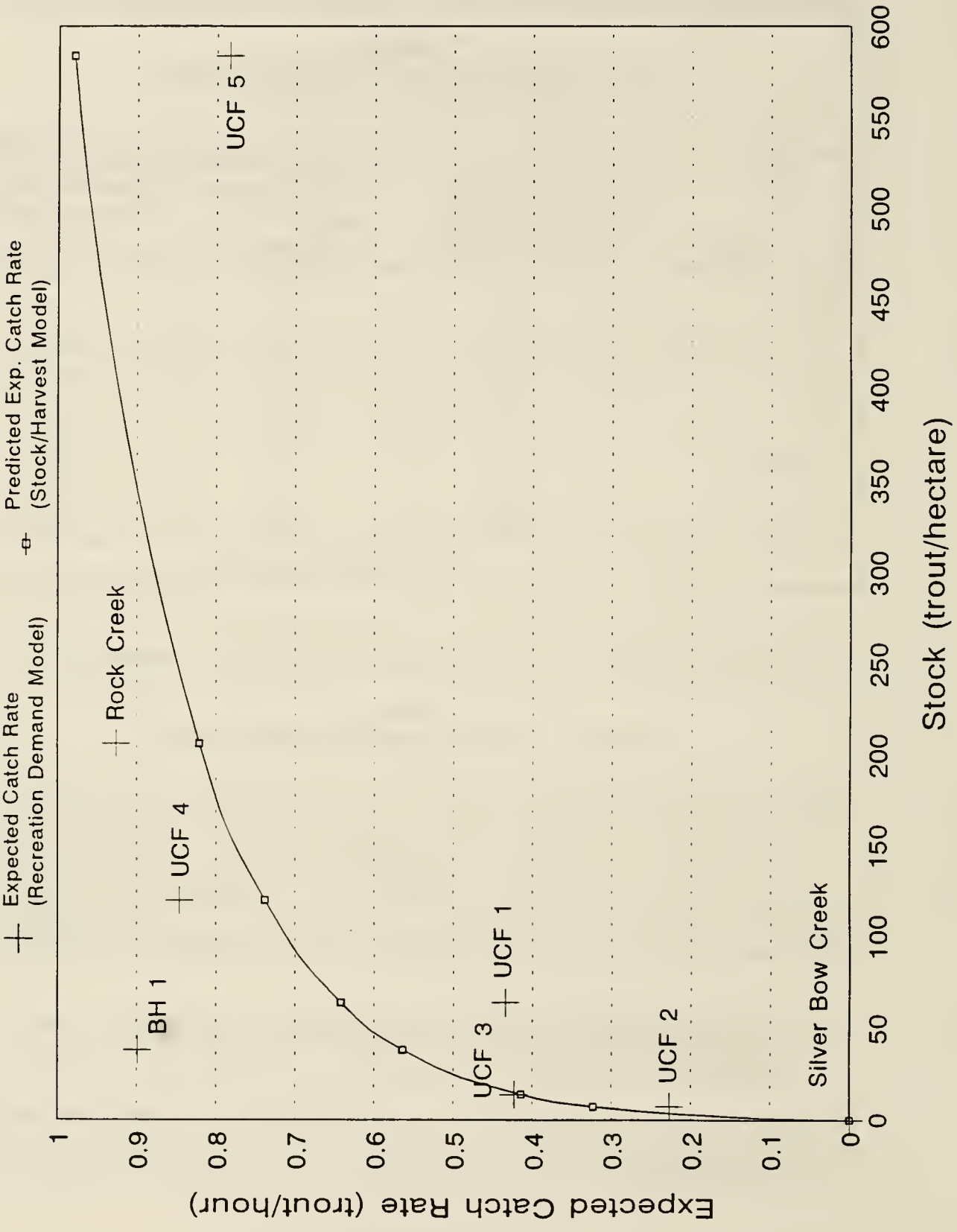
Table 6-3
Regression Statistics from Stock/Harvest Model

NOBS	R^2	Adj. R^2	F	$\hat{\phi}$ (t-stat)
8	0.93	0.92	98.26	0.1539 (9.91)

6.2 EXPECTED STOCKS IN THE CLARK FORK RIVER BASIN IN THE ABSENCE OF INJURIES

In the previous section, we report stocks for current conditions at the upper Clark Fork River sites and Silver Bow Creek. Now we report stocks for these sites if there were no injuries, i.e., the baseline stocks.

Figure 6-1
Expected Catch vs. Stock



In the injury quantification reports, stock data for Rock Creek, the Beaverhead River, Flint Creek, the Ruby River, Bison Creek, and the Big Hole River were used to estimate stocks at the upper Clark Fork River sites and Silver Bow Creek for the baseline (no-injury) conditions (Don Chapman Consultants, 1995).[3] These sites were selected as reference sites for the injured sites because they have ecological and geological characteristics, or *state types*, similar to segments in the upper Clark Fork River and Silver Bow Creek (Don Chapman Consultants, 1995). Adjustments were made for the effects of habitat and flow differences between the injured and reference sites. Table 6-4 compares stock estimates for the current (injury) and the baseline (no-injury) conditions.

Table 6-4
Stock Estimates for Current and Baseline Conditions
(trout/hectare)

River	Length in River Miles	Current (injured)	Baseline (no-injury)
UCF 1	16.7	63.82	146.85
UCF 2	35.1	7.14	107.62
UCF 3	27.4	13.78	40.80
UCF 4	34.1	119.98	780.33
UCF 5	2.0	583.70	453.60
Silver Bow Cr.	29.8	0.00	113.75

The largest differences between the current and baseline stock estimates are for Silver Bow Creek and Upper Clark Fork 2. The baseline stock estimate at Upper Clark Fork 2 is over 15 times larger than the current stock estimate. Note that the stock in Upper Clark Fork 5 is predicted to be somewhat larger in its current state than it would be in the baseline conditions; this is due to various man-made factors. Weighted by river miles (from Don Chapman Consultants, 1995), the average current stock for all sites in Table 6-4 is 47.9 trout per hectare. Under baseline conditions, the mile-weighted average stock increases by a factor of 5.5 to 263.4 trout per hectare.

[3] Stock estimates for the baseline (no-injury) conditions were calculated using the same weighting procedure as for current stock estimates. Flint Creek and Beaverhead were not used in the stock/harvest model because the stretches for which stocks were measured do not overlap with our angling sites.

6.3 USING THE STOCK/HARVEST MODEL TO CALCULATE EXPECTED CATCH RATES IN THE ABSENCE OF INJURIES

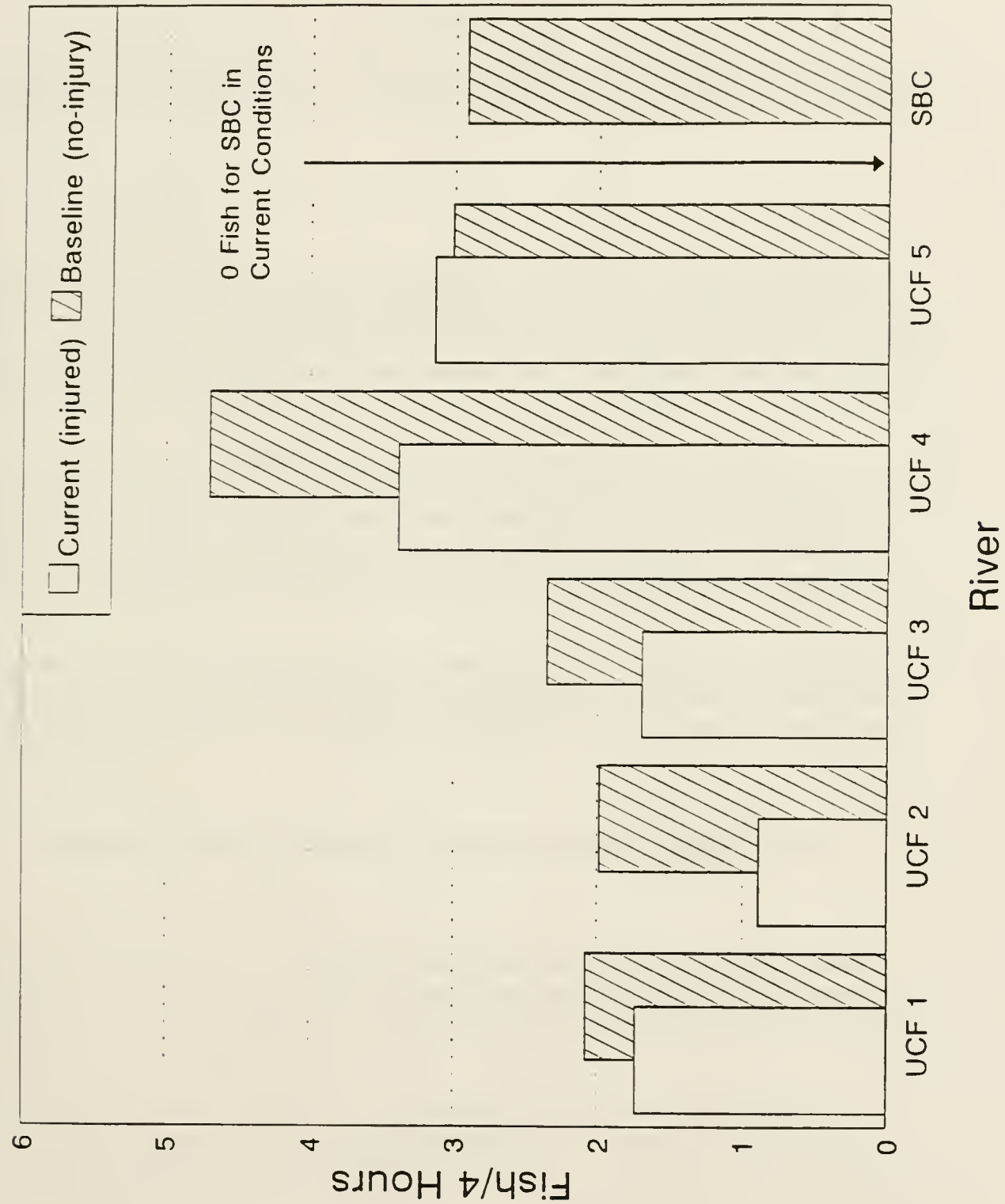
The stock/harvest model was used to estimate expected catch rates under the baseline (no-injury) conditions. Except for Silver Bow Creek, the baseline expected catch rate for each site was calculated by adjusting the current expected catch rate by the percent change in expected catch rates (from current to baseline conditions) predicted by the stock/harvest model. For Silver Bow Creek, which currently has zero stock, the best estimate of the expected catch rate in baseline conditions is that predicted directly by the stock/harvest model. Table 6-5 and Figure 6-2 compare expected catch rates for the current and baseline cases.

Table 6-5
Best Estimates of Expected Catch Rates for Current and Baseline Conditions

River	Length in Miles	Expected Catch Rates				Change per 4 Hours
		Current (injured)		Baseline (no-injury)		
		1 Hour	4 Hours	1 Hour	4 Hours	
UCF 1	16.7	0.434	1.736	0.520	2.080	0.344
UCF 2	35.1	0.222	0.888	0.496	1.984	1.096
UCF 3	27.4	0.423	1.692	0.587	2.348	0.656
UCF 4	34.1	0.846	3.384	1.174	4.696	1.312
UCF 5	2.0	0.784	3.136	0.753	3.012	-0.124
Silver Bow Cr.	29.8	0.000	0.000	0.730	2.920	2.920

The data in Table 6-5 can be used to compute the average change in catch rates across the impacted sites, weighted by the length of each site. Across all 145.1 river miles covered by the injured sites, the average change in expected catch per four hours of fishing, which is just less than the length of the average visit for residents, is 1.3 fish. This amounts to almost doubling (85 percent increase) the average expected catch rates over the 145 miles.

Figure 6-2
Expected Catch Rates per Four Hours of Fishing



CHAPTER 7
DEMAND FOR FISHING TRIPS AND BENEFITS UNDER BASELINE CONDITIONS AT THE CLARK FORK RIVER AND SILVER BOW CREEK

7.1 INTRODUCTION

The recreation demand model is used in this chapter to estimate how changes in expected catch at the upper Clark Fork River and Silver Bow Creek will affect site visitation by anglers. The results of the contingent behavior questions in the follow-up mail survey are used to confirm that the model predictions reflect the behavioral changes individuals anticipate they would make if catch rates change.

The changes in trip-taking patterns show that anglers are damaged by the reduction in expected catch rates at the upper Clark Fork River and Silver Bow Creek. The recreation demand model is used to estimate the value that existing anglers place on returning the impacted sites to baseline conditions. Finally, the use and value estimates are extrapolated to the relevant Montana angling population to derive total use estimates and total damages for 1992.

The reported use and value estimates omit the potential for an increase in the population of anglers due to the improved catch rates at the impacted sites, which results in a downward bias in the damage estimates. There would be more anglers if the sites had not been injured for many decades.

7.2 INCREASED FISHING ACTIVITY UNDER BASELINE CONDITIONS

7.2.1 Recreation Demand Model

The recreation demand model is combined with the estimated expected catch rates under baseline conditions (Chapter 6) to determine how many more fishing trips anglers would take under baseline conditions in 1992, and how those trips would be allocated across the rivers and streams in southwestern Montana.

The recreation demand model predicts that if baseline conditions were restored at the impacted upper Clark Fork River and Silver Bow Creek sites, an average resident angler active in river and stream fishing in southwestern Montana would take 0.355 more trips per year to the impacted sites and 0.316 fewer trips to other sites in Montana for a net increase of

0.039 trips per year. The predicted trips to the impacted sites are 66 percent higher under baseline conditions than under current conditions. This results from an 85 percent increase in expected catch rates at the impacted sites, indicating a significant but inelastic response by resident anglers.[1] Nonresidents are predicted to take more than double the current total number of trips to the impacted sites under baseline, indicating an elastic response. The average nonresident angler would take 0.070 more trips to the impacted sites and 0.062 fewer trips to other sites for a net increase of 0.008 trips per year. In summary, few new trips are predicted to be taken by existing anglers, but approximately five percent of trips to other sites are predicted to be substituted to the impacted sites when the impacted sites are returned to baseline conditions. These substitutions indicate that anglers are experiencing damage associated with the current, injury-caused reduction in catch rates.

The increase in visitation to the impacted sites under baseline conditions varies across sites. This variability reflects the variability in increased expected catch rates, as reported in Table 6-5. For example, under baseline conditions the expected catch rate at Upper Clark Fork 2 would increase by 123 percent, and the site would have a higher expected catch rate than sites such as Bitterroot 1, Blackfoot, and the Jefferson sites. The Upper Clark Fork 5 expected catch rate would experience little change, and visitation would decrease as trips are substituted to other sites. As compared to current conditions, the predicted visitation increases dramatically (83 percent) at Upper Clark Fork 2 under baseline conditions, indicating a significant but inelastic response to the increase in expected catch. Visitation at Upper Clark Fork 2 is predicted to exceed visitation at Jefferson 2, Yellowstone, Madison 1, and other popular sites. This reflects the relatively high expected catch rate at the impacted site under baseline conditions, the size of the site, and that this site is closer than other substitute sites for residents of nearby cities such as Missoula, Helena, and Butte (and therefore, there are lower costs associated with visiting the site).

Remediating injuries would also have a dramatic impact on Silver Bow Creek, making it an excellent small stream for trout fishing. The model predicts the proportion of trips to Silver Bow Creek would substantially increase if the site were returned to baseline conditions, and there would be more trips to Silver Bow Creek than to Flint Creek, Little Blackfoot, Jefferson 2, or Yellowstone. Without injuries the Clark Fork River and Silver Bow Creek would provide one of the better fishing areas in southwestern Montana.

The model predicts that under baseline conditions anglers will substitute fishing visits from other sites to the upper Clark Fork River and Silver Bow Creek. This implies that anglers are currently taking trips to sites that, under baseline conditions, would be less desirable due to lower catch rates or increased travel distances. The model predicts that many of the trips to the upper Clark Fork and Silver Bow Creek sites under baseline conditions will come from

[1] A response is deemed inelastic (elastic) if the trip increase in percentage terms is less than (greater than) the percentage increase in expected catch.

Rock Creek, Flint Creek, Bitterroot 2, Little Blackfoot, and the Big Hole River. These sites are at considerable distance from Upper Clark Fork 2 and Silver Bow Creek.

7.2.2 Comparison of the Contingent Behavior Responses to Predictions from the Recreation Demand Model

Questions 12 through 21 of the follow-up mail survey use contingent behavior (CB) questions to have anglers predict how their fishing behavior would change with changes in expected catch rates at selected sites (see Section 3.1). These CB results can be compared to the recreation demand model (RDM) results to verify whether the RDM results reflect angler perceptions on how their behavior would change with changes in catch rates at the impacted sites. For the comparison, the site used is combined Clark Fork 2 and 3. The hypothetical increases in catch rates are one, three, and five fish per four hours of fishing. The RDM was run to estimate changes in trip taking behavior for each of these three catch rate increases (assumed to occur uniformly across UCF 2 and 3), all with no change in catch rates at any other sites. The comparisons are presented in Table 7-1 and are discussed below.

Table 7-1
Comparison of Recreation Demand Model Predictions and Contingent Behavior Responses for Increases in Catch Rates at Upper Clark Fork 2 and 3

Increase in Catch at UCF 2 & 3 per 4 Hours of Fishing	Increase in Average Number of Trips to UCF 2 & 3		Decrease in Average Number of Trips to Other Sites	
Estimation Method	CB*	RDM**	CB*	RDM**
1 trout per 4 hours	0.36	0.08	-0.09	-0.07
3 trout per 4 hours	0.44	0.44	-0.04	-0.42
5 trout per 4 hours	0.81	1.32	-0.08	-1.27

* CB = contingent behavior responses; averages are based on small sample sizes (see Section 3.1) and contingent behavior questions that must be answered in one-trip increments. The CB averages are multiplied by one-third to account for the fact that sample anglers take more trips than the average angler in the population. This adjustment is already accounted for in the recreation demand model.

** RDM = Recreation Demand Model.

Both methods indicate that anglers would significantly increase their trips to UCF 2 and 3 with larger catch rates at UCF 2 and 3, and would decrease their trips to other sites. In the CB results, the average increases in trips for an increase in catch of 1 to 5 fish per 4 hours range from 0.36 to 0.81 trips per year. The RDM results for these scenarios range from 0.08

to 1.32 trips per year. The expected increases in catch rates associated with a return to baseline (no-injury) conditions is about one trout per four hours of fishing (Section 6.3).

Differences between the CB and RDM estimates of increases in trips to UCF 2 and 3 are due in part to the small sample sizes for the CB responses (Table 3-3), and to the required reporting of changes in trips in one-trip increments in the CB questions. The CB responses and the RDM estimates are consistent in predicting that Clark Fork Basin anglers are more responsive to improvements in conditions at the impacted sites than are anglers from outside of the Clark Fork Basin.

The average CB responses and RDM results differ in predicting the level of reductions in visits to other sites as the impacted upper Clark Fork sites are improved. CB respondents indicate that most of the increase in trips to the impacted sites will be new trips, while the RDM predicts that most of the trips will be substituted from other sites. In this regard the RDM is predicting a more conservative change in behavior than respondents directly indicate they would undertake.

7.3 PER ANGLER ESTIMATED ANNUAL WTP FOR BASELINE CONDITIONS

This section reports estimated means and standard errors of the per angler (resident and nonresident) annual willingness to pay in 1992 to obtain baseline expected catch rates at the Clark Fork River and Silver Bow Creek. These estimates are then evaluated and compared to prior estimates in the literature.

7.3.1 Per Angler Damage Estimates

The recreation demand model is used to estimate WTP for the baseline (no-injury) expected catch rates as a function of the angler's trip costs, age, gender, available free time, and other characteristics. See Appendix 7A for derivation of WTP. For anglers who are residents of Montana, estimated annual WTP ranges from $0.01 to $42.96 with a mean of $6.31 and a median of $4.54. For anglers who are not residents of Montana, estimated WTP ranges from $1.19 to $40.35 with a mean of $14.17 and a median of $12.62. These estimates are reported in Table 7-2. The distribution of WTP for residents is plotted in Figure 7-1, and the distribution of WTP for nonresidents is plotted in Figure 7-2. Mean WTP for active nonresident anglers is higher because they are willing to spend significantly more per trip and per year than residents to fish Montana's high quality trout streams; recall that while the mean trip cost for nonresidents is $840 (versus $77 for residents), nonresidents still take a large number of trips to Montana's rivers and streams (92,000 in 1992), and almost as many nonresidents as residents (65,000 versus 71,000) took such trips. Ignoring damages to nonresident anglers would cause a gross underestimate of damages.

Table 7-2
Annual WTP for the Baseline Expected Catch Rates at the Clark Fork River and Silver Bow Creek (in 1992 dollars)

WTP	All Anglers	Nonresidents	Residents
Mean	$9.01	$14.17	$6.31
Median	$7.03	$12.62	$4.54
Minimum	$0.01	$1.19	$0.01
Maximum	$42.96	$40.35	$42.96

Average annual damages of $6.31 for resident anglers and $14.17 for nonresident anglers are small and conservative estimates. For residents, $6.31 is approximately 8 percent of the average trip cost, and $14.17 is only 2 percent of the average trip cost for nonresidents. In comparison, nonresidents spend an average of $221 for lodging and $193 for equipment and guides, so $14.17 is not much to pay per year for the opportunity of significantly better fishing along over 145 miles at the injured sites.

Viewed in terms of what it would cost to travel to substitute sites rather than the injured sites, $6.31 would cover 36 additional round trip miles of annual fishing travel by a resident, and $14.17 would cover 66 additional round trip miles by a nonresident.[2] For illustration, Table 7-3 lists the approximate one-way distances from the center of Upper Clark Fork 2 and from the center of Silver Bow Creek (the impacted sites with the largest predicted changes in use) to primary substitute sites using major roads and highways. These distances average 55 miles for Silver Bow Creek and 63 miles for Upper Clark Fork 2.

An estimate of what each angler would pay per fishing trip for the opportunity to fish at the injured sites under baseline conditions can be derived by dividing each angler's annual damage estimate by the total number of fishing trips taken during the year. One can interpret these as estimates of what the angler would pay per trip for the option of baseline conditions. For residents, these estimates vary from $0 to $2.48 with a mean of $0.63. For nonresidents, they vary from $8.55 to $11.47 with a mean of $9.91.

An alternative per-trip measure is calculated by dividing annual damages by the predicted number of new trips annually to the injured sites under baseline conditions. If one assumes

[2] These calculations assume the sample average wage rate of $15 per hour for residents and $31 per hour for nonresidents, vehicle operating costs of $0.28 per mile, two anglers per vehicle, and an average travel speed of 45 mph.

Figure 7-1
Annual WTP for Resident Anglers

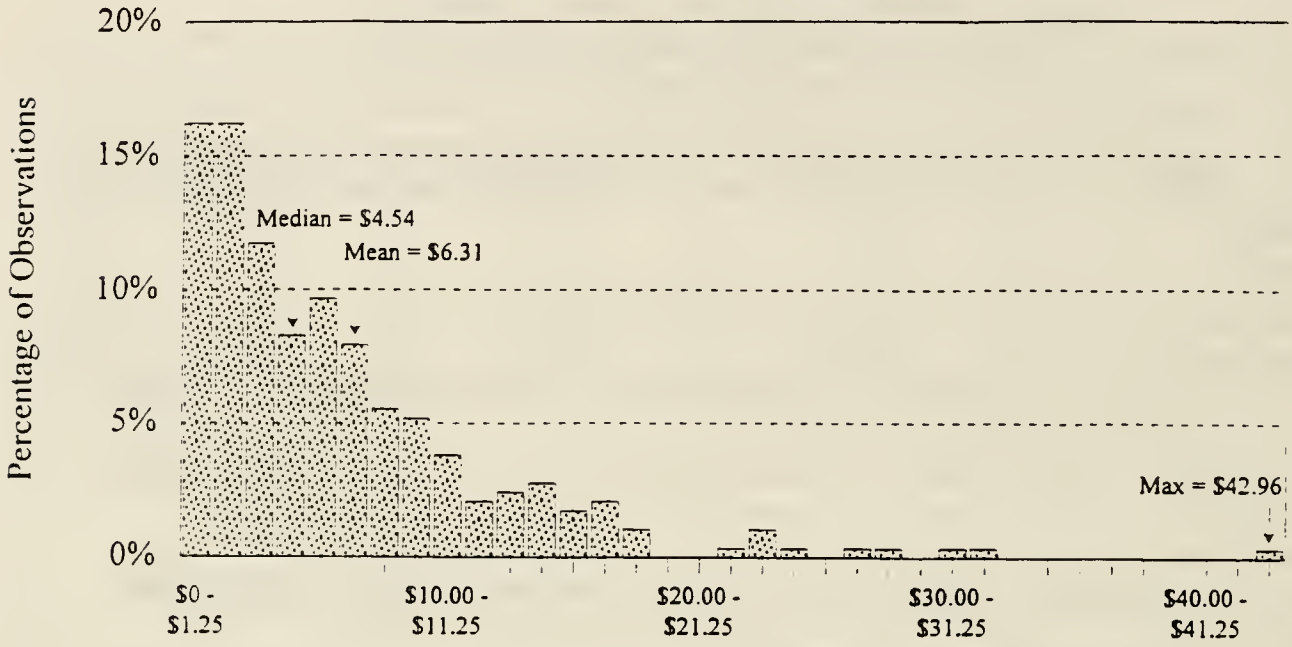


Figure 7-2
Annual WTP for Nonresident Anglers

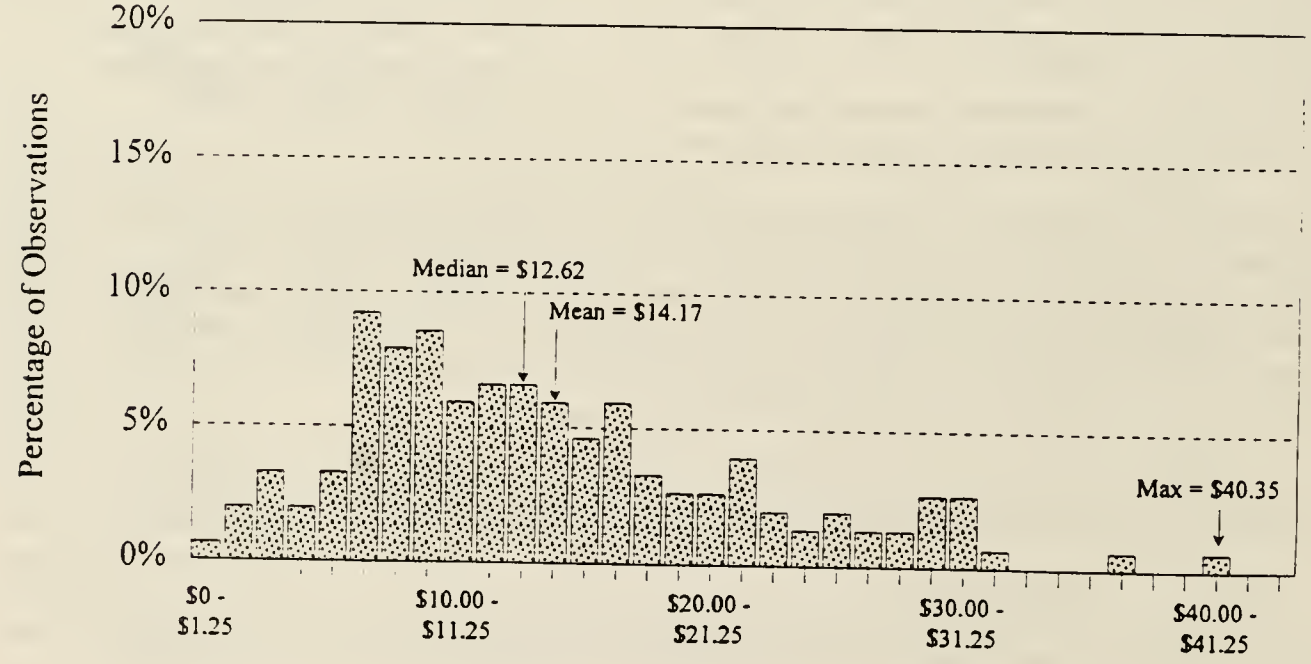


Table 7-3
One-Way Distances in Miles Between Selected Impacted and Substitute Sites

Substitute Site	Distance from Upper Clark Fork 2	Distance from Silver Bow Creek
Rock Creek	24	70
Little Blackfoot	44	46
Bitterroot 2	78	93
Big Hole 1	108	46
Big Hole 2	90	24
Flint Creek	33	49
Average of six distances	63	55

that all WTP from the recreation demand model is just for the new trips to the impacted sites, the average WTP per expected additional trip to the impacted sites for residents is $17.36. For nonresidents the average WTP per expected additional trip to the impacted sites is $201.05. The value per new trip for residents and nonresidents to the injured sites, weighted for additional trips to the injured sites, is $45.66.

This latter type of per-trip measure is often reported in the literature, and the value per additional trip from the recreation demand model can be shown to be comparable to the travel costs to visit substitute sites, many of which have similar or lower expected catch rates than the injured sites under baseline conditions. A value of $17.36 per resident trip for improvements in the impacted Clark Fork sites is comparable to the added vehicle and travel-time costs of substituting a fishing trip from another site located 48 miles away (one-way) from the impacted sites. Additional trips to the impacted sites under baseline conditions generally result from substituting trips from other southwestern Montana sites such as Rock Creek, the Little Blackfoot River, Flint Creek, the Bitterroot River, and the Big Hole River (see Table 7-3). For residents, $17.36 is only 23 percent of average trip costs. The value of $201.05 for nonresidents might seem high at first, but it is only 24 percent of the average trip cost for nonresidents and less than half of the typical nonresident per-trip expense for lodging and equipment alone. Also remember that nonresidents spend, on average, significantly more time fishing per trip (13.05 hours versus 4.88 hours for residents) indicating for nonresidents a WTP of $15.40 per hour for each additional hour of fishing at the impacted sites under baseline conditions.

These damages per new trip to the impacted sites are lower than comparable values reported in the literature. Several previous studies have estimated per-trip recreational fishing benefits for sites in southwestern Montana. For example, Duffield (1991) reported estimates of average net benefits per trip of $135 per trip for Rock Creek, $79 per trip for the Blackfoot, and $55 per trip for the Bitterroot. In Duffield's study, the difference in value per trip for the current

upper Clark Fork sites and for Rock Creek, which is similar to the impacted sites under baseline conditions, is about $90.00, which is approximately twice the average value for residents and nonresidents estimated by the recreation demand model of $46. Duffield et al. (1988) report estimates varying from $58 per trip for the Bitterroot to $228 per trip for the Madison.

Duffield (1989) also estimated the WTP per trip to avoid a fifty-percent decrease in the Rock Creek expected catch rate, a scenario similar to the improvement expected at the impacted sites if they are returned to baseline conditions, to be $80 to $100. Our estimate of $46 is approximately half as large.

WTP varies across individual anglers because trip costs and the other determinants of WTP vary across anglers. Consider the angler with the highest estimated WTP ($42.96), and compare this angler with an angler with a WTP that is effectively zero. The angler with a WTP of $42.96 resides near Silver Bow Creek, is a 52-year-old male, reports a skill level of 6 on a scale of 1 to 7, and reports 11 hours of free time on a typical weekday. This is an angler with low trip costs for the injured sites and a higher than average skill level and amount of free time. In contrast, the angler with a WTP of effectively zero is a 42-year-old male with a reported skill level of 4, five hours of free time on a typical weekday, and who lives approximately 270 miles from the injured sites. This angler has high trip costs and lower skill and free time.

In terms of the other determinants of estimated WTP, everything else constant, estimated WTP is an increasing function of fishing skill and hours of free time on a typical weekday. It is a decreasing function of age, years fished in Montana, and weeks of paid vacation. Everything else constant, estimated WTP is greater for males and greater for nonresidents.

In summary, under current conditions anglers are visiting sites other than those they would want to visit under baseline conditions, some with lower expected catch rates than Upper Clark Fork 2 and Silver Bow Creek at baseline conditions, and some at considerable distances from the impacted sites, which causes higher vehicle and travel-time damages to the anglers. Our damage estimates are lower than most values in the literature and comparable to the travel costs to visit substitute sites.

7.3.2 Standard Errors of the Mean Damage Estimates

Standard deviations for the estimated mean of the per angler damages were estimated through repeated simulations of the recreation demand model. Our estimated parameters and estimated variance-covariance matrix imply a distribution function for the model parameters. We randomly drew 500 parameter vectors from this distribution. For each of these parameter vectors we derived the WTP for each angler in our sample. This process generated an estimated distribution function for the mean WTP from which we estimated the standard

deviation of the mean. The estimated standard deviation of the mean is $3.13 for residents and $6.59 for nonresidents.

7.4 ESTIMATED TOTAL RECREATIONAL FISHING DAMAGES FOR 1992

To estimate total recreational fishing damages for 1992, we take the average damages for the study sample from the recreation demand model and extrapolate to all relevant Montana anglers, including residents and nonresidents. We estimate there were 71,239 resident anglers and 65,313 nonresident anglers active in river and stream fishing in southwestern Montana in 1992. See Appendix 3B for the derivation of this estimate.

Multiplying the estimates of the number of anglers who fish in southwestern Montana by our predictions of per-angler changes in trips to the impacted sites, and by the average damages per angler, leads to the following aggregate estimates for 1992:

- If the sites were not injured, in 1992 resident anglers would have taken 25,262 more trips to the impacted sites. Applying the mean resident annual damages of $6.31 to the 71,239 affected existing anglers results in annual damages of $450,000 (in 1992 dollars).

- The comparable estimate for nonresidents is 4,600 more trips to the impacted sites under baseline conditions. Applying the mean nonresident annual damages of $14.17 to the 65,313 affected existing anglers results in annual damages of $926,000 (in 1992 dollars).

- For both residents and nonresidents, there would have been 29,862 more trips to the upper Clark Fork River and Silver Bow Creek in 1992 if there had been no injuries. The total annual damages for both residents and nonresidents are estimated to be $1.4 million, which equals approximately $46 per new trip to the impacted sites (in 1992 dollars).

CHAPTER 8
NONFISHING RECREATION DAMAGES

8.1 INTRODUCTION

In this chapter we address nonfishing recreation damages along the upper Clark Fork River and Silver Bow Creek due to natural resource injuries. Nonfishing recreation along river corridors includes activities such as rest and relaxation, walking or hiking, observing wildlife, biking, RV camping, recreational boating, hunting, and other activities. River corridor natural resource quality is an important component of the aesthetic pleasure of many of these nonfishing recreation activities.

The release of hazardous substances and many of the same natural resource injuries that impact the fishing experience also impact the quality and quantity of nonfishing recreation. Injured water quality, injured fisheries and other aquatic life, contaminated streamside soils, reduced vegetation, and reduced wildlife can directly impact the ability of natural resources along the upper Clark Fork River and Silver Bow Creek to provide nonfishing recreation service flows, and therefore result in compensable use value damages. For example, the streamside tailings that impact the fishery also reduce vegetation and the desirability of a site for nonfishing recreation.

About one-third of parties with anglers include nonfishing recreators. Additionally, about one-half of parties with nonfishing recreators include anglers. As a result, natural resource injuries that affect the selection of a site for fishing visits also indirectly affect the selection of a site for many nonfishing recreation visits.

The analysis uses a straightforward approach to address nonfishing recreation along river corridors. First, we compute and analyze the ratio of changes in nonfishing recreation visits to changes in fishing visits. Next, this ratio is multiplied by the change in fishing visits to the impacted sites under baseline conditions to estimate the change in nonfishing visits to the impacted sites under baseline conditions. Finally, the change in nonfishing recreation visits is valued using a unit value approach.

The damage assessment is limited to nonfishing recreation along the upper Clark Fork River and Silver Bow Creek river corridors. Other nonfishing recreation impacts in lowland and upland areas away from the immediate river corridor are not quantified, and this omission results in a downward bias in the damage estimates.

8.2 THE IMPORTANCE OF NONFISHING RECREATION

Nonfishing recreation is an important activity in Montana. Statewide estimates of nonfishing recreation are available from the 1985 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, and recreation use data are available by region within the state (U.S. DOI, 1989). Hunting is a popular activity in our region, as shown in Table 8-1. In addition, according to the 1985 National Survey for the State of Montana, 241,000 people observed wildlife; 219,400 people fed wildlife; and 64,100 people took pictures of wildlife. Frost and McCool (1986) reported that 41.9 percent of all respondents to the Montana Outdoor Needs Survey hunted during the period from September 1, 1984 through August 31, 1985 in Montana Fish, Wildlife and Parks Region 2, which is the region surrounding Missoula that includes a portion of the Clark Fork Basin.

Table 8-1
1985 Montana Regional Hunting Participation*

	Region 2**	Region 3**
Hunting participation	19,500	40,900
Hunting days	175,500	791,400
Hunting trips	182,800	643,000
Big game participation	17,700	39,100
Big game days	112,000	294,900
Big game trips	98,100	236,000

* Source: 1985 National Wildlife Recreation Survey: Montana.
** Region 2 and Region 3 constitute most of the SW region of Montana.

Many other nonhunting activities also occur in Montana, and many of these activities take place along rivers and streams (BBER and UMT, 1989; Hagmann, 1979). These activities include rest and relaxation, walking, hiking, jogging, bird watching, nature study and photography, mushroom or berry picking, biking, RV camping, horseback riding, and boating.

Hagmann (1979) conducted a study from June 1, 1978 through May 31, 1979 to determine the nature and extent of recreation activities along the upper Clark Fork River between the confluence of Warm Springs and Silver Bow Creeks downstream to Missoula. The Little Blackfoot River, Flint Creek, Rock Creek, and the area adjacent to the Anaconda Company Settling Ponds were included in the study area. During this one-year period, Hagmann estimated there were 102,631 recreation visits, including fishing, in the study area. Approximately 80 percent of these trips were in the summer (June 1 through September 4), approximately 30 percent were at private campgrounds, and approximately 69 percent of trips

were by Montana residents. A summary of the estimated recreation visits for each primary recreation activity is provided in Table 8-2.

During summer months the ratio of nonfishing to fishing visits at the four Clark Fork basin river sites in the Hagmann study is 1.24, which indicates that 24 percent more visits occur along river corridors at the Clark Fork basin study sites for the purposes of nonfishing recreation than occur for the purpose of fishing. This ratio excludes recreation at private campgrounds along the upper Clark Fork River, which, if included, would likely increase the ratio as fishing is often only one of several recreation activities at these campgrounds.

8.3 NEW NONFISHING RECREATION DATA

Several primary data collection efforts were conducted in 1992 that provide additional information on nonfishing recreation along the Clark Fork River and along other river segments in the upper Clark Fork Basin. Most of these data were collected as part of the southwestern Montana recreational fishing study, as discussed in other chapters of this report.

1992 Postcard Study

As part of this study, a postcard survey was conducted of recreator parties along 26 river segments in southwestern Montana (see Section 2.3). Postcards were left on vehicles encountered along the intercept survey agent's route. On the postcard the respondent reports the recreation use at the site for all members of the party, separated into fishing and nonfishing activities. We use these data to compute the ratio of nonfishing trips to fishing trips along river corridors in southwestern Montana.

Across all study sites, 32.3 percent of individual anglers reported in the postcard survey data were accompanied by nonanglers. Therefore, natural resource injuries that alter the selection of fishing sites will concurrently impact the selection of sites for many nonfishing recreators. About 30.5 percent of all postcards were from nonfishing parties with no anglers, and 45.5 percent of postcards were returned by anglers with no nonfishing recreators. The remaining 24 percent of postcards were returned by parties with members engaged in fishing and nonfishing recreation. As a result, over 54 percent of recreator parties at the intercept sites included nonfishing recreators.

Additional results from the postcard survey are provided in Tables 8-3 and 8-4. The study finds that parties with nonfishing recreators are typically larger than fishing-only parties (Table 8-3). Average time at the site varies by month from about 4.6 hours to 6.2 hours per fishing visit and from about 3.6 to 5.8 hours per nonfishing recreation visit. The primary nonfishing activities included pleasure boating and other water activities (40 percent); camping and other bank activity (11 percent); picnicking, painting, walking, hiking, and

Table 8-2
1978 Participation Estimates for Upper Clark Fork River Study Area*

Activity	Summer Visits (June 1, 1978 - September 4, 1978)	Winter Visits** (September 5, 1978 - May 31, 1979)
Public Sites		
Fishing	23,364	7,632
Float fishing	1,565	58
Rest or relaxation	2,571	523
Walking	279	262
Picnicking	2,236	363
Sightseeing	894	0
RV camping	13,470	872
Water play	3,857	58
Photography	56	102
Tent camping	3,577	582
Floating	1,900	262
Nature study	56	218
Mushroom or berry picking	280	0
Trail biking	671	0
Hunting (total)	168	3,344
Big game		58
Waterfowl		3,068
Upland game birds		218
Other	950	262
Totals		
Public Sites	55,894	14,538
Private Campgrounds* **	26,529	5,670
Public and Private	82,423	20,208

* Source: Hagmann, 1979. Private campground use is not disaggregated by activity type. The study area included the Little Blackfoot River, Flint Creek, Rock Creek, and Warm Springs Creek; these figures do not include recreation at Rock Creek. About 48 percent of summer use is on the upper Clark Fork River, and about 62 percent of all visits are for the primary purpose of fishing.

** Winter use was not estimated at Flint Creek, Little Blackfoot River, or Warm Springs Creek.

*** The breakdown of campground use by activity can be approximated using Table 2 in the Hagmann study.

Table 8-3
Average Party Size*

River	All Postcards	Postcards with Fishing Only Parties	Postcards with Nonfishing Only Parties
UCF 1	2.526	1.829	3.032
UCF 2	2.375	1.444	2.650
UCF 3	3.500	2.500	4.600
Middle CF	2.888	1.870	3.270
Rock Cr.	2.591	1.960	2.893
Flint Cr.	2.391	1.706	3.000
Bitterroot 1	3.120	1.947	3.137
Bitterroot 2	4.693	2.468	4.385
Lolo Cr.	3.140	1.625	3.200
Blackfoot	3.346	2.222	3.494
L. Blackfoot	1.792	1.571	0.000
UCF 4	2.000	1.333	4.000
UCF 5	3.000	2.750	2.000
Big Hole 1	2.652	2.510	2.833
Big Hole 2	2.989	3.071	2.130
Jefferson 2	2.700	2.244	2.440
Beaverhead	2.958	2.088	6.772
Jefferson 1	2.600	2.368	2.405
Missouri	2.741	2.383	2.765
Yellowstone	3.495	2.222	2.105
Gallatin	2.060	1.662	2.375
E. Gallatin	1.702	1.459	1.750
Madison 1	2.919	1.744	3.384
Madison 2	2.735	2.294	2.692

* Omitted due to small sample sizes are Warm Springs Creek (1 obs.), Warm Springs Ponds, and Silver Bow Creek (0 obs.).

Table 8-4
Ratio of Nonfishing to Fishing Use*

River	Total # of Postcards Received	Total # of Anglers	Total # of Nonfishing Recreators	Ratio of Nonfishing to Fishing Visits
UCF 1	76	79	113	1.430
UCF 2	32	17	59	3.471
UCF 3	10	11	24	2.182
Middle CF	125	110	251	2.282
Rock CR.	115	148	150	1.014
Flint CR.	23	36	19	0.528
Bitterroot 1	108	67	270	4.030
Bitterroot 2	88	221	192	0.869
Lolo CR.	57	36	143	3.972
Blackfoot	136	91	364	4.000
L. Blackfoot	24	39	4	0.103
UCF 4	4	4	4	1.000
UCF 5	12	28	8	0.286
Big Hole 1	92	178	66	0.371
Big Hole 2	94	183	98	0.536
Jefferson 2	90	144	99	0.688
Beaverhead	119	201	151	0.751
Jefferson 1	75	75	120	1.600
Missouri	251	469	219	0.467
Yellowstone	95	198	134	0.677
Gallatin	133	125	149	1.192
E. Gallatin	47	60	20	0.333
Madison 1	149	127	308	2.425
Madison 2	268	552	181	0.328
Total	2,223	3,199	3,146	0.980

* Omitted due to small sample sizes are Warm Springs Creek (1 obs.), Warm Springs Ponds, and Silver Bow Creek (0 obs.).

jogging (8 percent); and other activities, including those who indicated they were involved in a nonfishing activity but did not indicate the specific activity (41 percent).[1]

The ratio of nonfishing to fishing recreation visits varies across sites, as reported in Table 8-4. For comparison to Hagmann's results, the ratio is computed for all nonfishing activities for the comparable sites on the Clark Fork River (UCF 1 through UCF 5, Little Blackfoot, Flint Creek, and Rock Creek); it is 1.05. The difference between the nonfishing to fishing ratio in Hagmann (1.24) and in the postcard study (1.05) can be attributed to differences in site definitions, the study year, and sampling methods. The same ratio for all southwestern Montana sites in the postcard survey is 0.98, and for just the injured Clark Fork sites it is 1.50. The higher ratio at the injured sites may reflect that fishing recreation has been impacted to a greater degree by injuries at these sites than has nonfishing recreation.

The sampling method in the postcard survey is likely to understate nonfishing recreation along river corridors. The postcard intercept sites were primarily selected to support the analysis of fishing recreation. Sites that might be more frequently visited by nonfishing recreators were not necessarily included in the postcard survey plan. As a result, the data from the postcards can be expected to understate the number of nonfishing recreators *vis-à-vis* fishing recreators along rivers in southwestern Montana, and to lead to understated damage estimates for nonfishing recreation.

1992 Boating Study

During 1992, a recreational boating survey was conducted as part of this study. This study was completed by boaters (primarily float trips intercepted at put-in or take-out points) concurrent with the fishing intercept survey. The survey includes 89 boaters who indicated that they were not fishing from their boats. These nonfishing boat-trip interviews occurred primarily along the Missouri, Madison, and Blackfoot rivers. The survey instrument is in Appendix 8A. While floating, many individuals were involved in a number of other activities, as summarized in Table 8-5. Many of these activities would be affected by the types of natural resource injuries that currently occur along the upper Clark Fork River and Silver Bow Creek.

End-of-Season Mail Survey

As part of the fishing study, a mail survey was completed at the end of the summer season by anglers (see Chapter 2 for discussion and Appendix 2A for a copy of the survey instrument). Recreators who are not anglers are not included in this survey. Anglers rated the quality of nonfishing recreation as less important to the selection of a fishing site than other site characteristics presented to them (Table 3-1), although nonfishing is still ranked in the middle

[1] The activity for those who failed to write it in is likely to be any of the listed activities except recreational boating, because boating is explicitly listed on the postcard survey.

Table 8-5
Summary of Boating Intercept Survey*

	Activity/Category	Number Who Participated in the Stated Activity (number who answered the stated question)
A.	Stated that floating was the primary purpose of the trip	73 (85)
B.	Other activities engaged in (multiple activities allowed)	— (63)
	Birdwatching	30
	Camping	13
	Hiking	6
	Picnicking	27
	Swimming	29
	Wildlife viewing	42
	Doing "other" activity	2 - Photography 4 - Floating 2 - Fishing
C.	Montana residents	69 (75)

* Based on recreation boating intercept survey of 89 individuals at 26 river segments chosen for the recreational fishing analysis.

of the importance scale. Because most anglers (about two-thirds in the postcard survey) are not accompanied by nonfishing recreators on their fishing trips, it is reasonable that fishing characteristics of a site would be more important to the selection of a site than nonfishing characteristics of a site for anglers.

The correspondence between the quality of fishing and nonfishing recreation at river sites is apparent in the survey data. As reported in Table 3-4, ratings by anglers of seven selected sites for nonfishing quality are highly correlated with the ratings of the sites in terms of perceived catch rates. Combined Upper Clark Fork 2 and 3 and Upper Clark Fork 4 are rated as the worst two of the seven sites for both fishing and nonfishing recreation (Questions 4 through 7).

1992 Bitterroot Flyovers

During 1992, the Montana Department of Fish, Wildlife and Parks conducted regular flights over the Bitterroot River and took aerial photographs from which recreation counts were

made.[2] The photographs are sufficiently detailed to allow classification of individuals as either bank anglers, float anglers, or those on nonangling float trips. Those individuals engaged in nonfishing bank recreational activities were not counted. The ratio of nonfishing float trip visits to all fishing visits ranged from two to twelve depending on the time of year. If other nonfishing recreation activities were included, the ratio of nonfishing to fishing recreation would be even higher. This again provides support that nonfishing recreation is important along river corridors in southwestern Montana.

8.4 COMPUTING CHANGE IN NONFISHING RECREATION USE ALONG THE INJURED RIVER CORRIDORS UNDER BASELINE CONDITIONS

In this section we compute the change in nonfishing recreation trips along the upper Clark Fork River and Silver Bow Creek. First, we compute and analyze the ratio of the change in nonfishing recreation trips to the change in fishing trips. This analysis is based on regression analysis and simple comparisons of fishing and nonfishing trip-taking behavior, both using the postcard data. The ratio is applied to the increase in fishing trips to the impacted sites under baseline conditions (from Chapter 7) to estimate the increase in nonfishing recreation trips to the impacted sites under baseline conditions.

Comparison of Ratios Method

A simple comparison of nonfishing to fishing ratios at sites in southwestern Montana can be used to infer the change in nonfishing trips for a change in fishing trips to the injured sites. At the impacted Clark Fork River and Silver Bow Creek sites, the ratio of nonfishing to fishing trips is 1.5. The same ratio for the uninjured sites (all other sites) in the region is 0.96. The difference in the ratio between the injured and uninjured sites indicates that fishing trips to the injured sites may be affected more by injuries than are nonfishing trips. If in baseline conditions the ratio at the impacted sites were to be the same as the average of all other sites, then the ratio of the change in nonfishing to the change in fishing will be less than 0.96 (so that the current average of 1.5 is decreased to 0.96 after the sites are returned to baseline conditions, reflecting that fishing trips will increase by more than nonfishing trips). Using this logic, we can compute the ratio for the change in nonfishing to the change in fishing at the impacted sites as follows (trips are rounded to the nearest 100):

1. In Section 7.5 we estimated current fishing trips (in 1992) to the impacted sites of 42,400. If current nonfishing recreation is 1.5 times current fishing recreation, then there are currently 63,600 nonfishing recreation trips to the impacted sites.

[2] This information was obtained from D. Workman, Montana Department of Fish, Wildlife, and Parks.

2. In Section 7.4 we estimated an additional 29,900 fishing trips to the impacted sites under baseline conditions, for a total of 72,200 fishing trips. If under baseline conditions the ratio of nonfishing to fishing recreation trips is 0.96, then the number of nonfishing trips under baseline conditions is 69,300 (72,200 × 0.96).

3. The estimated change in nonfishing recreation trips is 5,800 (69,300 - 63,600). The ratio of the change in nonfishing recreation trips to the change in fishing trips is therefore approximately 0.19 (5,800/29,900).

This method may overstate or understate changes at the impacted sites under baseline conditions to the degree that the ratio at all other sites may vary from that at the impacted sites under baseline conditions. Using the ratio for all sites is preferred to arbitrarily selecting individual sites for comparison because it embodies more information and is less sensitive to differences among individual sites.

Regression Methods

Using the 1992 postcard survey data, alternative ratios of nonfishing recreation visits to fishing recreation visits are estimated based on two sets of data:

1. Postcard data for all fishing and nonfishing visits. This ratio can then be applied to the change in all fishing visits to estimate the change in all nonfishing recreation visits.

2. Postcard data for only those parties with both fishing and nonfishing members. This ratio can then be applied to the 32.3 percent of fishing visits where nonfishing recreators accompany the anglers to estimate the change in the number of nonfishing recreation visits accompanying increased angler visits.

Regression models are used to explain nonfishing trips to the sites included in the postcard intercept survey (some of the 26 sites were deleted due to lack of sufficient observations) and are reported in Table 8-6. Models 1 and 2 explain the number of nonfishing visits to a site as a function of fishing visits to the site and other site characteristics. In Models 1 and 2 the coefficient on "Fishing Trips" is the estimated rate of change in nonfishing visits for a change in fishing visits to the site. Also included in the regressions are "Flow," which is the average summer flow at the site; "Campground," which equals 1 if a campground is directly adjacent to the site (this variable is identical to the variable used in the recreational fishing analysis), and equals zero otherwise; and "Gravity," which is the population of the nearest large city divided by the distance of this city from the site.[3]

[3] Catch rate at the site is not included in Models 1 and 2 because the number of anglers at the site depends on this variable and is already modeled in the multinomial logit fishing model.

Table 8-6
Nonfishing Recreation Trip Regression Results

Variable	Estimated Coefficient (t-stat)	
	Model 1 All Postcards	**Model 2 Postcards with Both Fishing and Nonfishing Recreation Members**
Dependent Variable	**Nonfishing Recreation Trips***	**Nonfishing Recreation Trips***
Constant	-0.006 (-0.036)	5.191E-5 (0.002)
Fishing trips*	0.330 (1.938)**	0.907 (10.870)**
Flow	5.612E-5 (0.956)	6.295E-6 (0.727)
Length		
Gravity	6.910E-8 (0.441)	6.949E-9 (0.333)
Campground	0.392 (2.024)**	0.014 (0.535)
Expected catch rate		
R^2 F value # Observations	0.47 4.45 25	0.93 60.8 23

* Fishing and nonfishing are per mile and per interviewer visit to the site.
** Coefficient is significant at the 5 percent level.

Other variables such as "Campground" are included because they may not change just because natural resource quality is returned to baseline conditions, and therefore they are held constant in the analysis. However, as sites are improved there will be increased pressure to improve access and facilities to support public use of the natural resources, which will enhance the desirability of the sites for nonfishing recreation. By including "Campground," the growth in such facilities has been fixed at zero in the analysis, which results in conservative estimates of increased nonfishing recreation at the Clark Fork River and Silver Bow Creek.

Regression Models 1 and 2 are statistically significant, as is the level of fishing trips in explaining the level of nonfishing recreation in these two models. Model 1 is based on data for all anglers and nonfishing recreators in the postcard sample. The coefficient on fishing trips (0.33) indicates that for each 100 additional fishing trips, an additional 33 nonfishing recreation trips are expected to occur.

Model 2 is based on the postcard data for parties with both anglers and nonfishing recreators. This model is very significant and indicates that, for parties with both fishing and nonfishing members, each additional fishing trip results in 0.91 additional nonfishing recreation trips. Given that about 32.3 percent of anglers are accompanied by nonfishing recreators, for every 100 additional fishing trips there will be about 29 nonfishing recreation trips by individuals accompanying anglers (100 additional fishing trips × 0.323 with nonfishing members × 0.91 change in trips by nonfishing members = 29). The results of Model 2 indicate that improvements in fishing quality, which lead to increased fishing trips to a site, have a direct and significant effect on the number of nonfishing recreation trips taken to the site as well. The results of Model 2 indicate that the change in nonfishing by members of parties with both anglers and nonfishing recreators is about 88 percent (using regression Model 1) of the change in all nonfishing trips.

Applications

We have considered several methods to evaluate the ratio of the change in nonfishing recreation to the change in fishing recreation at the impacted sites when they are returned to baseline conditions. We select the ratio of 0.30 for this analysis based on Models 1 and 2. These models are preferred to the simple ratio approach because they account for selected site characteristics. Model 2 indicates that for each new angling trip there is almost one additional nonfishing recreation trip, which is consistent with the sample data. Model 2 will understate increases in nonfishing trips because it does not include new nonfishing recreation trips that are unaccompanied by anglers. Model 1 predicts a slightly higher ratio (0.33) because it includes trips by nonfishing recreators not accompanied by anglers.

Under baseline natural resource conditions, 29,862 additional angler trips are estimated to occur along the upper Clark Fork River and Silver Bow Creek in 1992 (see Section 7.4). Applying our estimate of the nonfishing to fishing ratio predicts the addition of 8,959 nonfishing recreation trips under baseline resource conditions in 1992 (8,959 = 29,862 × 0.30).

If the percent of new nonfishing recreation visits versus visits that are substituted from other sites is the same as for fishing visits, then approximately 89 percent of the additional nonfishing recreation visits are visits that would have otherwise been taken to other sites, and approximately 11 percent of the increase in nonfishing recreation visits are new nonfishing recreation trips.

8.5 ECONOMIC VALUATION OF NONFISHING RECREATION AND CALCULATION OF DAMAGES

The valuation of nonfishing recreation impacts uses the considerable literature on nonfishing recreational use values to select a per-trip value to be applied to the change in nonfishing recreation trips to the sites under baseline conditions. This methodology may be used under both the current and proposed NRDA regulations: "Unit values are preassigned dollar values for various types of nonmarketed recreational or other experiences by the public. Where feasible, unit values in the region of the affected resource and unit values that closely resemble the recreation or other experience lost with the affected resource may be used" [43 CFR § 11.83 (c)(2)(vi)].

Selecting a unit value is complicated by the mix of different nonfishing activities that would occur along the upper Clark Fork River and Silver Bow Creek under baseline conditions, and because the reported values in the literature are from different studies and locations, which may have a different quality of recreation than in Montana. To overcome these issues, the literature is reviewed to develop a ratio of values for nonfishing trips versus fishing trips. As reported in Appendix 8B, a ratio of 60 percent is selected. This means that across many studies the average value of nonfishing trips, for the mix of activities at the impacted sites, is about 60 percent of the average value for fishing trips. In Section 7.3.3 it was reported that the WTP per expected additional fishing trip to the injured sites is $45.66.[4] Applying the ratio of 60 percent, we use a per-trip value for impacted nonfishing recreation trips of $27.39. The 1992 damages to nonfishing recreators are therefore $27.39 times 8,959 additional nonfishing recreation trips reported in Section 8.4, or $245,000 (in 1992 dollars).

The above analysis provides conservative estimates of nonfishing recreation damages for the following reasons:

- The nonfishing recreation impacts away from the Clark Fork River and Silver Bow Creek river corridors are omitted. These injuries were shown to exist, but are not quantified in the injury assessment.

- The postcard sampling procedure may understate nonfishing recreation *vis-à-vis* fishing recreation. Consequently, our selection of 0.30 as the coefficient relating the change in fishing trips to nonfishing recreation trips is conservative.

[4] WTP of $45.66 is an average for both residents and nonresidents weighted by the additional number of trips for each, which are reported in Section 7.4.

CHAPTER 9
REFINEMENTS AND REBUTTAL COMMENTS

9.1 OVERVIEW

In July 1995, ARCO submitted its expert reports critiquing the State's recreation analysis (McFadden, 1995; Desvousges and Waters, 1995a). This revised report includes revisions that reflect continued refinements by the State, and reflect useful comments provided in the ARCO reports. However, many ARCO comments are either incorrect or misleading, as discussed in this chapter.

A summary of the major ARCO comments and how they are treated is contained in Table 9-1. The first column includes the general comment topic and where in the ARCO reports these comments are found. The second column indicates how and where in the State recreation report the issue is addressed, and the third column indicates if and where additional rebuttal comments are provided in this chapter.

9.2 MAXIMUM LIKELIHOOD ESTIMATION

ARCO raises several concerns about the specification and estimation of the State's model. These include the inclusion of too many dummy variables (McFadden, page 29); failure to achieve a global maximum of the likelihood, a necessary condition for proper parameter estimation (McFadden, page 29; Desvousges and Waters, pages 6-8); and difficulty estimating standard errors of parameter estimates (McFadden, page 29; Desvousges and Waters pages 9-11). These issues are not a concern in the revised report. A redundant dummy variable was eliminated, and the model is now fully identified. Estimation of the model with the refinements makes the other points moot.

The State has provided a carefully specified parametric model of angler behavior that satisfies all the usual economic and econometric conditions (such as identification) for empirical analysis. Furthermore, the State has used the preferred method of maximum likelihood (ML) estimation, and the implementation of that method has followed usual econometric custom in every regard. In contrast, Drs. Desvousges and Waters (1995b) report damages using the less desirable stepwise procedure, which Hausman, Leonard, and McFadden (1993, page 20) indicate leads to statistically inefficient estimates. Specifically, (1) the algorithm the State used to find the maximum of the likelihood function converged according to standard criteria (small change in function value; small derivatives with respect to model parameters; and

Table 9-1
Treatment of ARCO Comments on the State's Recreation Model

ARCO comments relating to:*	Addressed in: The State's Recreation Analysis (how and where)	Chapter 9, Section:
Maximum likelihood estimation (M 6-7, 28-30; DW 6-11).	Estimation is robust, meets all usual requirements. Chapter 5, Appendices 5B and 5C.	9.2
Vehicle operating costs (M 17).	Vehicle cost plausible and consistent with literature. Appendix 5A.	9.3
Treatment of expected catch rates (M 5-6, 13-16; DW 11-15).	Estimated expected catch rates fully consistent, both theoretically and empirically. Chapters 4 and 5.	9.4
Modeling substitute sites (DW 19-21, M 20).	No sites omitted. Lake and others included but aggregated. Chapter 4.	9.5
Sample angler average number of trips (DW 30-37, M 32-33).	Estimation weights applied. Appendices 3B and 5B.	9.6
Sampling procedures (M 13-16, Appendix 9; DW 24-29).	Site trip proportions effectively weighted by method of sampling. Chapter 2.	9.7
Effects of fishing pressure (M 26-27, App. 11).	—	9.8
Nonresident travel costs (DW 16, M 17-18).	Now vary across sites for all nonresidents. Section 5.1.	9.9
Resident/Nonresident differences (DW 17-18, M 23).	Separate price and ECR parameters estimated. Section 5.3.	9.9
Omitted variables (DW 18-19, M 24).	Five site variables added; angler skill levels considered. Section 5.2.	9.9
Treatment of income (DW 23, M 32, Appendix 12).	Site choice no longer a function of income. Section 5.2.	9.9
Value of time (M 21-23).	Estimated by the model. Section 5.1.	9.9
Stock/Harvest Model (DW 40-48).	Chapter 6	9.9
Nonfishing recreation damages (DW 49-54)	Chapter 8	9.9

* M = McFadden (1995).
DW = Desvousges and Waters (1995b).

small change in estimated parameters); (2) there is ample evidence of achieving a global maximum (the fact that the algorithm converged to the same value, with the same value of parameter estimates, from different starting points); and (3) the end result of estimation is the calculation of standard errors for parameter estimates in the usual way (inversion of the Hessian matrix). Therefore, the State's econometric analysis has been established to be statistically reliable according to generally accepted standards of estimation.

9.3 VEHICLE OPERATING EXPENSES

The State used a per-mile vehicle operating cost of $0.275 in 1992 dollars. This is the amount the State paid its employees to drive their vehicles for job-related activities in 1992. Dr. McFadden (page 17) states that this value is too high, in that it contains costs such as depreciation and insurance, arguing (without citation) that previous travel cost studies support his contention. There is ample evidence to suggest that this is a reasonable figure, and that individuals are aware of the true and full cost of driving. Therefore, no changes to the State's model were made.

The calculations of vehicle operating costs for different organizations are summarized below for comparison. A standard mileage rate is used by the federal government in lieu of actual costs for reimbursing employees. The number of miles driven does not affect the rate; both individuals who drive their cars very little and individuals who drive frequently are reimbursed using this rate. The rate provides a precedent that is appropriate for a compensation case such as the Clark Fork case. This rate represents costs relating to depreciation, maintenance, repairs, tires, gasoline, gasoline taxes, oil, insurance, and registration fees. This rate was $0.29 in 1993 and $0.28 in 1992. The standard mileage rate is reported in the U.S. Internal Revenue Service (IRS) Cumulative Bulletin, Volume 2 (1992). An independent consulting firm computes this rate for the federal government, and the details of the analysis are unavailable from the IRS.[1] The IRS rate applies collectively to cars, vans, pickups, and panel trucks.

According to the Chief of the Administrative Accounting Bureau of the State of Montana, it is a Montana state law to use the IRS rate from the previous year as the current year's vehicle operating cost.[2] Because of inflation, the state rate for a given year is typically lower than the federal rate for that year.

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[1] L. Friedman, United States Internal Revenue Service, pers. comm. ((202) 622-4920).

[2] MCA codes 2-18-503, 3rd para.

Rates used by other organizations were also investigated. Hertz and other car rental agencies no longer compute or use per-mile vehicle operating costs.[3] In a document used by its members to calculate their own trip expenses, the American Automobile Association (AAA) computes a rate composed of components similar to those in the IRS rate, but the AAA rate is significantly higher (AAA, 1994). The AAA rate is based on costs that fall into two categories, operating costs and ownership costs. Operating costs comprise costs for gas, oil, maintenance, and tires. Ownership costs comprise taxes, depreciation costs, finance charges, registration fees, license fees, and insurance.[4] AAA's 1994 composite national average for three models of vehicles is between $0.35 and $0.48 per mile for those driving 20,000 miles and 10,000 miles per year, respectively.[5] It is possible that the AAA rate is higher than the IRS rate because the AAA rate includes license fees and depreciation charges, although this cannot be confirmed because detailed IRS computations are unavailable. The average 1994 cost per mile for the AAA's direct operating costs is about $0.09. However, adding only the depreciation costs from footnote 4 increases that value to $0.24 per mile, which is similar to the IRS rate and the rate used in the Montana recreation study.

Much of the published, peer-reviewed travel cost literature does not report how vehicle operating costs are computed. These include Hellerstein (1991); Hausman, Leonard, and McFadden (1993); Parsons and Needelman (1992); Parsons and Kealy (1992); and Needelman and Kealy (1994). Vehicle operating costs per mile in these studies range from approximately $0.13 to $0.24 in 1992 dollars.[6] Two studies use respondent-reported data on vehicle operating expenses. Hanemann et al. (1987) use each individual's reported vehicle cost per mile for each individual. No summary statistics are reported for this variable. Creel and Loomis (1990) use the reported sample average of approximately $0.24 per mile in 1992 dollars. We identified one study that reported an external source for their mileage rate. Jones and Sung (1991) use $0.31 in 1992 dollars, which is the AAA adjusted 1984 rate.

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[3] Hertz stopped in 1987.

[4] AAA's ownership costs have some components that vary with mileage. For example, depreciation and insurance are directly tied to mileage. Consider a $15,000 automobile that can be driven, on average, 100,000 miles. The depreciation costs for that car are $0.15 per mile. More expensive vehicles might be expected to have even higher per-mile depreciation costs. Blue book values for used cars also are conditional on mileage. Further, insurance rates increase for higher mileage (D. Brooks, Allstate insurance agent, pers. comm. (303) 494-0907).

[5] Ownership costs per mile fall overall with increased mileage. The three models are the 1994 Ford Escort LX, the 1994 Ford Taurus GL, and the 1994 Chevrolet Caprice Classic.

[6] Values are adjusted using the U.S. Consumer Price Index. The magnitude of vehicle operating costs is not reported in Hausman, Leonard, and McFadden (1993).

An issue that may arise relating to this topic is the type of vehicle used for angling trips. If old cars and trucks are used for these trips, it might be argued that depreciation costs are minimal and should not be included. First, this is highly speculative. Second, older vehicles with more miles on them are likely to need more repairs than the average vehicle and have lower miles per gallon. Third, the older the vehicle the closer to the decision to replace. In short, the issue of vehicle type has offsetting cost components and there is no reason to suspect that accounting for it would be anything more than an unnecessary complication.

In conclusion, the mileage rate used by the federal government provides a precedent that is appropriate for the Clark Fork case, and this rate is consistent with rates used in the literature. Furthermore, the recreation demand model is optimized to explain trip-taking behavior as a function of per-mile vehicle costs and per-mile time costs. The value of time is estimated endogenously in the model to find the value that best explains trip-taking behavior.

Given this evidence, to state that anglers do not pay attention to the costs of operating a vehicle (McFadden, page 17) is to make the assertion that individuals are not rationale in their decision making, a position that would invalidate almost all of economic research (including Dr. McFadden's work on transportation demand). Occasional trips may be made without considering depreciation, but anglers and others are acutely aware of the total costs of their driving.

9.4 THE CONCEPT OF AN EXPECTED CATCH RATE

9.4.1 Theory

As part of the recreational (fishing) demand model, the State estimates expected catch rates (ECRs), which are measures of what an angler expects a representative angler would catch on an average trip to each site (Section 4.2). Dr. McFadden (pages 6-6 and Section 4.2.1.4 and 4.2.2.7) indicates the State is inconsistent in its use of the concept of ECR. This is not correct. The state uses the ECR variable in a consistent manner in its analysis. What may be causing confusion is that the State also measures angler perceptions about catch at a subsample of sites. This alternative measure is used as a consistency check that the ECR measure is consistent with angler perceptions.

Dr. McFadden further worries that omitted variables in an analysis could cause estimates of these ECRs to be biased, as an omitted variable might be serving as a proxy for both ECR and other site characteristics. But other site characteristics are included in the State's

recreation demand analysis (Section 4.2.1).[7] Therefore, the estimated ECR is measuring what it is supposed to be measuring — the average number of fish a representative angler could be expected to catch at a particular site.

In addition, and as suggested by Dr. McFadden, the State's model now uses a Poisson distribution for the catch rate component of its model. The Poisson distribution is better suited to the discrete nature of catch (0, 1, 2, . . . fish) and especially to the significant number of reported zero catches. The correlation between the estimated ECRs and the simple average (Poisson) catch rates is high, and even higher when weighted by fishing hours or calculated among all but the least-fished sites. Moreover, there is a strong correlation between estimated ECR and anglers' rating of the sites in terms of perceived catch. The statement ". . . the State's estimated ECRs will be inconsistent with the State data on fish catches (page 6) . . ." is incorrect: the State's estimated ECRs are completely consistent with observed catch rates and trip frequencies, as discussed in detail in Chapter 5 of the State's recreation report.

9.4.2 Estimation

The State has estimated ECRs based on observed catch data *and* angler trip-taking behavior. Dr. McFadden calls the statistical procedure of combining sources of information correct but worries about it being ". . . vulnerable to bias . . . from omitted factors" (pages 25-26). In this regard, the State has added site characteristics and tested other site characteristics — see Sections 4.2.1 and 9.9. The Desvousges and Waters statement that "Visitation was the driving force behind the calculation of the ECRs, with the observed catch rates serving only as a starting point" (page 12) is incorrect with respect to the January 1995 report and is demonstrated to be incorrect in this revised report (see Sections 4.1 and 5.4).

Combining sources of information with the goal of better parameter estimation has a long history in econometrics.[8] Moreover, the econometric specification used in this analysis for calculation of expected catch rates leads to more reliable estimates and is completely consistent with standard econometric practice.[9]

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[7] Even if other significant site characteristics were omitted (and one can always speculate that some potentially significant variable may be omitted from any regression model (including the State's and ARCO's models), it is not *a priori* determined that the omission biases the ECR coefficient estimate upward or downward, or that it induces any bias at all.

[8] Examples include Durbin (1953), Theil and Goldberger (1961), and Theil (1971, pages 346-352).

[9] According to Dr. McFadden, "It is a correct statistical proposition that when an explanatory factor in a behavioral model is measured with error, there is information in behavioral response that can in principle be combined with the direct measurement of the factor to provide a better estimator of the level of the factor" (pages 25-26).

In travel cost models the measure of expected success is typically estimated independently of where anglers take trips and how frequently they go there. However, *biological* information, such as observed catch or fish biomass, due to its inherent nature, is often subject to significant variability. To reduce the uncertainty in this important concept, in the model reported here this biological information is combined with *behavioral* information on the actions of anglers. Combining the data in this way is valid under the assumption that, after controlling for other site characteristics such as distance and site amenities, anglers will go where they will catch more fish, an extremely plausible assumption. Put another way, given two identical sites, anglers will prefer the site where they will catch more fish, and will tend to take more trips to that site. In the traditional method (such as that employed in Desvousges and Waters (1995b)), this information is ignored.

This use of all information is especially important when there are sites with few measurements on catch rate. Traditional model estimates of catch rate at a site (total fish caught divided by total reported fishing time) will be less precise the fewer the observations on catch (for example, at UCF 4 with nine observations eliminating one observation causes the simple average catch rate to drop by half). A site with few observations is more likely to have a poorly measured expected catch rate if it is estimated to be just the simple average because the sampling variation is so high. The State's estimation method is carefully designed to weight the biological and behavioral information accordingly. For sites with few observed catch rates the ECR will be more determined by angler trip behavior, while the opposite will be true for sites with many observed catch rates.

Suppose the true ECR is low, but at an infrequently visited site a few anglers caught more fish than usual. In the traditional model the estimated expected catch rate based only on the observed catch data will be upwardly biased. In the State's model, the high simple average catch rate will be downweighted due to the fact that it is a function of few observations. The estimated expected catch rate will be closer to the true ECR, because of this downweighting and because there were few trips to the site. This balancing of information is exactly what the model is intended to do. In general, the estimated catch rates are highly correlated with the actual catch rates (see Section 5.4) and with anglers' perception of catch rates. Where they differ, the predicted catch rates from the State's model are to be preferred, because of the power of the model.

9.5 MODELING SUBSTITUTE SITES

The State identified 26 river and streams sites in southwestern Montana for intensive study. They included the impacted sites, and a variety of substitute and comparable sites. All other rivers and streams in Montana are included in the model as generic "other" fishing options. Lake fishing and all other substitute recreation options are included in the nonfishing (at rivers and streams) option. Therefore, every possible fishing site and type of fishing are in the angler's choice set in the State's model, but some are included in the "other" categories.

Dr. McFadden in Section 4.2.2.3 and Desvousges and Waters (pages 19-21) incorrectly argue that the State's damage estimates are biased upward because of limited substitute sites. Their argument is, essentially: "When there are fewer substitutes available, anglers' value for any one site is higher than if there are more substitutes" (Desvousges and Waters, page 21). This is true but irrelevant. The State did not restrict substitution, rather it aggregated some substitutes where knowledge of site characteristics was limited. In particular, all lake sites were combined with the nonfishing alternative, and all river and stream sites that were not in the group of 26 intensively studied sites were aggregated by region. For reliable econometric estimation, one needs to allow for all substitutes, but it is not necessary to specify each site individually. Neither the State nor ARCO argue that all substitute sites and activities must be included individually.

The State calculated damages based upon the estimated coefficients of catch rate and other variables in the model. There is no theoretical evidence that aggregating sites (and imputing values of unknown variables for those aggregate sites) biases particular coefficients upwards. There is empirical evidence that aggregating sites may cause bias in parameter estimates and bias in damage estimates, but the bias can be in either direction. This has been shown empirically for recreation demand models by Parsons and Needelman (1992). Aggregating sites may bias estimated damages downward when aggregation increases measurement error in the explanatory variable such as expected catch rate and costs.

9.6 CORRECTING FOR SAMPLE ANGLER AVERAGE NUMBER OF TRIPS

Due to the intercept nature of the sampling, individuals in the State's sample are likely to take more fishing trips than the population average. This fact has implications in the estimation of the model because one possible choice in the choice set is "nonfishing." It could be expected that this alternative would be chosen less frequently than if a random sample had been drawn.

In this revised report, choice-based weights were used. Following conventional practice borrowed from the transportation choice literature, choices (fishing or nonfishing) were weighted by the ratio of estimates of the population probability of the action to the sample probability of the action (see Manski and Lerman, 1977).

9.7 SAMPLING PROCEDURES

One of the major criticisms of the State's recreation report is that the distribution of intercepted recreators at the intensively studied sites is not necessarily representative of the distribution of all recreators at these sites. Dr. McFadden devotes a section of his report (4.2.1, pages 13-16) and Appendix 9 to this issue. The same points are raised by Desvousges and Waters (pages 24-29). First, this discussion misstates the issue. Estimates of important

model parameters may be biased if the distribution of trips, not recreators, in the sample is not similar to that of the population trip proportions. Second, ARCO's experts imply that the State either did not weight its observations or the weights used are suspect. The State did weight its observations. Dr. McFadden (Appendix 9) provides alternative weighting schemes, but the alternatives have no more, and probably less, validity than the State's procedure. Therefore, no changes to the model are required.

Dr. McFadden's text makes it appear that the State has estimated a choice-based sample with no thought to weights. In fact, the State's sample was weighted to match an estimate of the population proportion of site visits. This is indicated in the State's recreation report (Chapter 2, Data Collection and Survey Design) under the discussion of the anglers chosen to be followed. The State weighted by randomly sampling intercepted anglers at each site in proportion to the number of anglers at each site. The high correlation (0.94) between the State's sample site trip proportions (Table 3-5, page 3-11, first column) and the best estimate of the population trip proportions (Table 2-4, page 2-10, third column) indicates that the State has done very well with its follow-up surveys in mimicking the population proportion of site visits.

Dr. McFadden presents a long appendix (Appendix 9) purporting to demonstrate that the State's sampling proportions vary significantly from the State's own estimates of the population shares as well as from each of three other estimates of the population shares that he estimates. His conclusions from this appendix are incorrect or misleading as to their significance. To begin with, Dr. McFadden computes the State's sample share as the relative share of 513 anglers in the follow-up surveys (Appendix 9, Table 9-1, column 8). This is taken directly from the State's report (Chapter 2, Table 2-4). But these 513 anglers were not all contained in the final model. As is explained in Chapter 3, the final sample consisted of 443 anglers. The statement: "Column 8 gives the share of the State sample from each site" (McFadden, page 9-4) is simply incorrect, because 443 and not 513 anglers were used in estimation. Dr. McFadden's entire three page Table 9-1 is therefore erroneous, as it depends upon column 8, the shares for the sample of 513 anglers.

Dr. McFadden states (page 14) that ". . . if there is any deviation of sampling proportions from target population proportions, . . . weighting is required . . . if bias is to be avoided." In the State's study there is no need for sample intercept trip proportions to match population trip proportions. Dr. McFadden is incorrectly viewing the intercept sample and subsequent estimation in the same context as choice-based sampling in the transportation modal choice literature, where he is an expert. In those models, a commuter is sampled at a site regarding his observed choice of transportation mode. The unit of observation is the commuter, and weighting is necessary because the observed trip has been site-sampled. That is, the intercept trip proportion *is* the sample trip proportion. This is not the case in the State's report. In the State's report, the unit of observation is an angler-trip occasion, not an angler, and for anglers their trip records for the entire season, and not just for the intercepted trip, are available. In Table 3-5 proportions are computed for all angler trip-occasions to the intensively studied

sites, and therefore represent the State's sample proportions. Again, for this additional reason, Dr. McFadden's statement: "Column 8 gives the share of the State sample from each site" is incorrect, because the ratios in column 8 are calculated from intercepted trips only, and not from all trips.

Dr. McFadden presents four alternative weighting schemes. The fourth is based on data from the returned postcards and is very close to the approach, and has nearly identical weights, as in the State's analysis. The first and second methods are based on postcards distributed, adjusted for anglers per party from the returned postcards. These alternatives are not necessarily better or worse than the fourth alternative. Dr. McFadden's third alternative is to use 1985 visit data from Duffield et al. (1992b). This study was seven years old when the State's study was conducted and, naturally, has its own issues when applied to the State's exact river segments under study. The postcard data is preferred because it matches both the exact river reaches defined in the study and the year of the study.

9.8 EFFECTS OF FISHING PRESSURE

Improved biological conditions implies an increase in fish stocks followed by an increase in ECR and hence angler utility. The State has estimated site damages based upon the most immediate and predominant effect of improvements in the biological conditions at the damaged sites. Dr. McFadden (pages 26-27) has argued that increased *fishing pressure* resulting from higher ECRs would eventually lead to a secondary effect of lower stocks at the restored sites, and hence lower damage estimates.[10] This is not a sound argument for reducing estimated damages. Higher fishing pressure at one site implies lower fishing pressure at all other sites. Lower fishing pressure at other sites would cause stocks to increase at the other sites, according to the simple stock/harvest model used by Dr. McFadden in Appendix 11 of his report. This makes fishing more desirable at other sites and leads to an offsetting benefit at other sites.

9.9 MISCELLANEOUS MODELING ISSUES

In Section 3.1.4 and throughout his text, Dr. McFadden has discussed a number of other modeling decisions. Many of these observations are repeated in Desvousges and Waters. Most of these issues have been addressed or are irrelevant. Specifically:

[10] Even the premise here is in doubt. Many anglers suggested catch-and-release on all rivers or increasing the number of rivers where catch-and-release is required (Table 3A-5).

- Drs. Desvousges and Waters (page 16) and Dr. McFadden (pages 17-18) have criticized the State's treatment of travel costs for nonresidents. Intrastate travel costs now vary across sites for all nonresidents.

- Drs. Desvousges and Waters (pages 17-18) and Dr. McFadden (page 23) have suggested that resident and nonresident anglers should be modeled separately. The State's model has been further generalized to allow the effect of price and expected catch rate to vary by resident status. Residents and nonresidents do vary significantly in their preferences for fishing Montana's rivers and streams. A separate recreation demand model was also estimated for residents. This resident-only model generates results very similar to those of the model which combines residents and nonresidents.

- Drs. Desvousges and Waters (pages 18-19) and Dr. McFadden (page 24) criticize the State for omitting relevant explanatory variables. They claim that the omission of site and individual characteristics biases upwards the estimated parameter on ECR. Five additional site characteristics were investigated to determine if they would increase the explanatory power of the model. The explanatory power of the model was improved by adding a variable for whether there was a campground adjacent to the site, and by adding variables that explain whether the site is suitable for float fishing. Variables indicating the uniqueness of Silver Bow Creek in terms of its attractiveness (it is ugly) and the uniqueness of Upper Clark Fork 3 in terms of access were found not to be significant determinants of participation or site choice.[11] In addition, the model has been generalized to allow the effect of catch rate on participation and site choice to vary by resident angler skill level. Finally, ARCO's experts are simply speculating as to whether other characteristics are omitted and whether such potential omissions bias damages in any direction.

- Drs. Desvousges and Waters (page 23) and Dr. McFadden (page 32 and appendix 12) argued that the treatment of income in the State's model is incorrect. The recreation model no longer assumes that participation and site choice are functions of income. This new assumption was adopted to simplify the model, and it is the assumption made in the ARCO model. This eliminates from consideration any questions concerning income in the calculation of damages.

- Dr. McFadden (pages 21-23) has argued that the State used too high a value of time in recreation. Other work has used rules of thumb from previous studies or relied on "expert judgment." The State's opinion is that the value of time varies with the situation, and relying on past studies or anyone's judgment could be seriously misleading. Therefore, the State has let the data determine the value of time. That is, the specification of the State's model allows the value of time to be estimated along

[11] Aesthetics were also found to be insignificant in Devousges and Waters (1995b).

with the rest of the unknown parameters. This is the position taken by Hausman, Leonard, and McFadden (1993, page 17) in their work on the Exxon Valdez oil spill.

- Drs. Desvousges and Waters (Section 5) argue that the State's stock/harvest model is flawed by the omission of a constant term in the regression analysis. When a constant is included in the State's model, the constant is statistically insignificant, as theory suggests. Moreover, there is a close fit to the data (Table 6-2) with the functional form chosen by the State.

- The Desvousges and Waters argument that there are insufficient data to estimate the stock/harvest model is fallacious. A problem with insufficient data is manifested in imprecise parameter estimates, but this is not the case in the State's results — the estimated coefficient on stock has a very large t-statistic. Desvousges and Waters purport to show that there is not a significant correlation between stock size and ECR (pages 47-48). They estimate the effect of stock on ECR after including the proportion of nonresidents at the site as an additional explanatory variable and after excluding Silver Bow Creek from the data. They find that for the functional form specified, stock does not influence catch. This conclusion is counterfactual and caused by the fact that they chose an additional explanatory variable (proportion of nonresidents) that is correlated with both stock and estimated ECR, and because Silver Bow Creek was omitted. This is a textbook example of spurious correlation (and not causality) resulting in their nonsensical conclusion: ". . . a change in stock will have no effect on expected catch rate . . ." (page 48).

- Drs. Desvousges and Waters assert that the State's nonfishing recreation analysis ". . . is an unconventional approach that is not supported by the economic and scientific literature" (page 49). Quite the contrary is true. The State measures changes in fishing visits to the injured sites. Next, using the postcard data the State measures how nonfishing recreation trips change with changes in fishing trips. For instance, the State measures that about 30 percent of anglers are accompanied by a nonfishing recreator, leading to 30 additional nonfishing recreation visits for each 100 angler visits. Damages are computed using the accepted approach of applying a unit value to the change in nonfishing visits to the injured sites [43 CFR § 11.83 (c)(2)(iv)]. This straightforward analysis is no more unconventional than standard sampling and statistical inference. The State's approach is conservative because it omits damages associated with other nonfishing recreation at these and other sites and omits casual enjoyment of the injured sites.

Chapter 10
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Appendix 2A
Intercept Survey Instruments

Intercept Survey Instruments
Postcard Survey Instrument
Wave 4 Logsheet
Wave 5 Logsheet
Wave 6 Logsheet
Wave 7 Logsheet
Wave 8 Logsheet

SOUTHWESTERN MONTANA 1992 SPECIAL USE FISHING INTERCEPT STUDY

SET-UP

INTERVIEWER CODE _____ RIVER CODE _____ ID# _____ TIME _____

MONTH/DAY ____/____

DAY TYPE 1 WEEKDAY 2 WEEKEND RAIN/BAD WEATHER? 1 NO 2 YES

TIME BLOCK 1 7:30-2:30 2 11:00-6:00 3 2:30-9:30

AGE GROUP 1 SENIOR 2 ADULT 3 JUVENILE

GENDER 1 MALE 2 FEMALE

FLOAT TRIP? 1 NO 2 YES FLY ROD? 1 NO 2 YES

TRIP WAS 1 COMPLETE 2 INCOMPLETE 3 ANGLER JUST ARRIVING

O1 Hello, my name is _____. I'm conducting a fishing use survey on this river for the Montana Department of Fish, Wildlife and Parks. It would help us in the management of this river if I could ask you a few questions about your fishing today. May we have your help?

1 NO ➢ We hope you enjoy your fishing trip. ➢ ➢ END OF INTERVIEW

2 YES ➢ Thank you. Are you just starting to fish today? YES ➢

NO ➢ CONTINUE

O1A If Float Trip, at what location did you put in your boat? _____ (nearest landmark)

O2 Are you a full-time or part-time resident of Montana, or a non-resident?

1 FULL-TIME RESIDENT ➢ County of Residence ➢ _____

2 PART-TIME RESIDENT (owns or rents in Mont.) ➢ Nearest City/Town ➢ _____

3 NON-RESIDENT

State of Residence (If Part-time or Non-resident) _____

Is the primary purpose of having a Montana Residence to (Circle all that apply):

1 FISH OR HUNT 2 WORK, or 3 OTHER REASONS

THIS TRIP: I would like to ask you some questions about your trip here to the _____ river, focusing on this section between _____ and _____.

O3 Sometimes people combine fishing trips with other activities. Was fishing the primary purpose of this trip? (A "trip" is any time you leave home or your part-time residence.) 1 NO 2 YES

O4 What time did you actually start fishing on this segment of the _____ river today? _____ START

O5 How many trout have you personally caught (including caught and released) so far today on this segment of the _____ river? _____ #TROUT

O6 Of the _____ trout you caught, how many were greater than 16" long? _____ #>16"

O7 Did you catch any fish other than trout on this segment of the river? 1 NO 2 YES

(IF YES, How many?) _____ #OTHER

O8 How many more hours do you think you will fish today on this segment of the river? _____ HOURS

O9 In total, how much time will you spend fishing on this segment of this river on this trip? _____ HOURS

O10 In total, approximately how much money did you *personally* spent on this fishing trip for tackle and equipment and any guide or outfitters? (do not include food or gas for auto) _____ $EQUIP

O11 How many nights do you expect to be away from home on this trip? _____ NIGHTS

IF > 0 nights ➢ How much, if anything, did you spend or do you expect to spend in total for lodging for these _____ nights away from home? _____ $LODGING

O12 Did you visit other segments of this river, or other rivers or streams on this trip? 1 NO 2 YES

IF YES ➢ What other rivers or streams did you fish on this trip?

	Site(s)-river name and nearest landmark	Region Code	River Code
1.			
2.			
3.			

YOUR LAST TRIP THIS YEAR

Q13 Prior to this trip, how many fishing trips have you taken since May 1st of this year to fish at rivers or streams in Montana? [IF ZERO SKIP TO "ABOUT YOU" BOX] _____ TRIPS

Q14 In what month did you take your last trip? _____ MONTH

Q15 What rivers or streams did you fish at on your last trip?

	Site(s)-river name and nearest landmark	Region Code	River Code
1. (Primary site)			
2.			
3.			

Q16 On the _____ river (primary site), how many hours did you spend fishing? _____ HOURS

Q17 In those _____ hours, how many trout did you catch (including catch and release) on the _____ river (primary site)? _____ #TROUT

Q18 How many of those trout were greater than 16 inches in length? _____ #>16"

ABOUT YOU

Q19 Your age? _____ YEARS

Q20 Are you: (circle all that apply) 1 EMPLOYED FULL-TIME 2 EMPLOYED PART-TIME 3 A HOMEMAKER 4 A STUDENT 5 RETIRED, or 6 UNEMPLOYED

Q21 It is extremely helpful to the study if you can categorize your approximate hourly wage rate as:
1 LESS THAN $10/HR 2 BETWEEN $10 - $20/HR 3 MORE THAN $20/HR

Q22 Are you on vacation during this trip? 1 NO 2 YES

Q23 Have you taken this survey before? 1 NO 2 YES

To better manage this and other rivers in Montana, we may want to contact you by mail or phone to find out about other fishing trips you may take this summer. The follow-up will only take a small amount of your time. Would you be willing to help us by giving your name, address and phone number?

1 YES ➢ NAME _____
ADDRESS _____
CITY _____ STATE _____ ZIP _____
PHONE (___) _____

2 NO

Thank you for participating in our study!
Comments

Check box if they ask to see results from the survey ☐.

POSTCARD SURVEY INSTRUMENT

1992 Angler Creel Survey
Montana Rivers and Streams

Montana Department of Fish,
Wildlife and Parks
3201 Spurgin Road
Missoula, Montana 59801

To help us manage this river, please complete the reverse side and mail. Thanks!

ID: River/site: Date: Time: License:

WHAT TIME DID YOU PARK your car here? ____ (circle one: AM PM)
WHAT TIME DID YOU DRIVE AWAY? ____ (circle one: AM PM)

NUMBER OF PEOPLE traveling together in this vehicle_____.

SINGLE PRIMARY ACTIVITY FOR EACH PERSON, related to nearby stream:

____ number of BANK OR WADING ANGLERS

____ number of anglers FISHING FROM BOAT

____ number of RECREATIONAL BOATERS, not fishing

____ number engaged in OTHER RECREATION

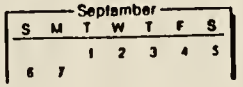
____ number in OTHER activity (PLEASE SPECIFY):_____

TOTAL: ____ should equal number of people traveling in this vehicle.

IF INDIVIDUAL COMPLETING THIS CARD fished the nearby stream, how long did you personally fish? ___ HOURS ___ MINUTES. How many trout did you personally catch (including catch and release)?
_____ TOTAL TROUT CAUGHT.

THANKS FOR YOUR HELP!

Please keep track of the total trips you take. Record the number of trips to rivers and streams in Montana by marking each date that is the first day of a trip.



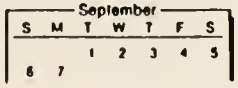
Southwestern Montana Rivers 1992 Special Use Study - Wave 4 Logsheet					
Trip (anytime you leave home to go fishing)	Month in which trip took place	Region in which you fished (See map): Missoula Area Butte Area Bozeman Area Other Area	Did you fish at more than one river or stream on this trip? Yes or No	Name of river where you primarily fished and the name of the nearest town or landmark	Code # for your Primary Site (if it is one of the sites on the map)
PLEASE RECORD INFORMATION FOR THE FIRST THREE TRIPS YOU TAKE AFTER YOU RECEIVE THIS LOG					
1st trip					
2nd					
3rd					
NOW PLEASE RECORD INFORMATION FOR THE FIRST THREE TRIPS YOU TAKE AFTER JULY 24TH					
1st trip					
2nd					
3rd					
NOW PLEASE RECORD INFORMATION FOR THE FIRST THREE TRIPS YOU TAKE AFTER AUGUST 21ST					
1st trip					
2nd					
3rd					

If you have any questions, please feel free to call (406) 721-2165.

Please keep track of the total trips you take. Record the number of trips to rivers and streams in Montana by marking each date that is the first day of a trip.

July						
S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

August						
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

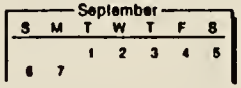


September						
S	M	T	W	T	F	S
		1	2	3	4	5
6	7					

Southwestern Montana Rivers 1992 Special Use Study - Wave 5 Logsheet					
Trip (anytime you leave home to go fishing)	Month in which trip took place	Region in which you fished (See map): Missoula Area Butte Area Bozeman Area Other Area	Did you fish at more than one river or stream on this trip? Yes or No	Name of river where you primarily fished and the name of the nearest town or landmark	Code # for your Primary Site (if it is one of the sites on the map)
PLEASE RECORD INFORMATION FOR THE FIRST THREE TRIPS YOU TAKE AFTER YOU RECEIVE THIS LOG					
1st trip					
2nd					
3rd					
NOW PLEASE RECORD INFORMATION FOR THE FIRST THREE TRIPS YOU TAKE AFTER AUGUST 14TH					
1st trip					
2nd					
3rd					

If you have any questions, please feel free to call (406) 721-2265.

Please keep track of the total trips you take. Record the number of trips to rivers and streams in Montana by marking each date that is the first day of a trip.



Southwestern Montana Rivers 1992 Special Use Study - Wave 6 Logsheet					
Trip (anytime you leave home to go fishing)	Month in which trip took place	Region in which you fished (See map): Missoula Area Butte Area Bozeman Area Other Area	Did you fish at more than one river or stream on this trip? Yes or No	Name of river where you primarily fished and the name of the nearest town or landmark	Code # for your Primary Site (if it is one of the sites on the map)
PLEASE RECORD INFORMATION FOR THE FIRST THREE TRIPS YOU TAKE AFTER YOU RECEIVE THIS LOG					
1st trip					
2nd					
3rd					
NOW PLEASE RECORD INFORMATION FOR THE FIRST THREE TRIPS YOU TAKE AFTER AUGUST 28TH					
1st trip					
2nd					
3rd					

If you have any questions, please feel free to call (406) 721-2265.

Please keep track of the total trips you take. Record the number of trips to rivers and streams in Montana by marking each date that is the first day of a trip.

August

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

September

S	M	T	W	T	F	S
		1	2	3	4	5
9	7					

Southwestern Montana Rivers 1992 Special Use Study - Wave 7 Logsheet

Trip (anytime you leave home to go fishing)	Month in which trip took place	Region in which you fished (See map): Missoula Area Butte Area Bozeman Area Other Area	Did you fish at more than one river or stream on this trip? Yes or No	Name of river where you primarily fished and the name of the nearest town or landmark	Code # for your Primary Site (if it is one of the sites on the map)
PLEASE RECORD INFORMATION FOR THE FIRST THREE TRIPS YOU TAKE AFTER YOU RECEIVE THIS LOG					
1st trip					
2nd					
3rd					

If you have any questions, please feel free to call (406) 721-2245.

Please keep track of the total trips you take. Record the number of trips to rivers and streams in Montana by marking each date that is the first day of a trip.

August

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

September

S	M	T	W	T	F	S
		1	2	3	4	5
6	7					

Southwestern Montana Rivers 1992 Special Use Study - Wave 8 Logsheet					
Trip (anytime you leave home to go fishing)	Month in which trip took place	Region in which you fished (See map): Missoula Area Butte Area Bozeman Area Other Area	Did you fish at more than one river or stream on this trip? Yes or No	Name of river where you primarily fished and the name of the nearest town or landmark	Code # for your Primary Site (If it is one of the sites on the map)
PLEASE RECORD INFORMATION FOR THE FIRST THREE TRIPS YOU TAKE AFTER YOU RECEIVE THIS LOG					
1st trip					
2nd					
3rd					

If you have any questions, please feel free to call (406) 721-2265.

Appendix 2B
Telephone Follow-Up Survey Instruments

Telephone Questionnaire
Telephone Survey Response Rates by Wave

Montana Southwestern Rivers Fishing Study Telephone Questionnaire

Q1 Survey Agent number _____

Q2a Date of Last Contact by Intercept _____ Q2b Date of Last Contact by Phone _____

Q3 Current Date _____

Q4 Respondent ID number: _____

Dial the Telephone Number. If young child answers, ask for an adult.

Q5 Hello. I would like to speak with _____ , is s/he at this residence? 1 Yes 2 No

If No, then read: the number I was calling is _____ and it was for _____ (respondents first and last name) If number is not the respondent's phone number, thank them and end the interview. Note on call record - wrong number.

If Yes, wait for person to come to the phone and...

Q6 My name is _____ and I am calling on behalf of the Montana Department of Fish, Wildlife, and Parks. You were interviewed on (date) on the (river or stream name) for the Southwestern Rivers Special Use Study in Montana. I'd like to ask you a few questions about your recent fishing trips. Is now a good time to ask you these questions?

1 Yes ---> Continue
2 No ---> When would be a more convenient time to call? _____

Q7 Did you receive the log sheet we sent you and is it handy?

1 Yes ---> Continue
2 No ---> If No, Skip to BRANCH II.

BRANCH I - LOGSHEET.

Wait for them to get the log sheet.

Q8 Please refer to your log sheet and map if you need to.

How many trips to Montana streams or rivers have you taken since (fill in date last the time s/he was interviewed in person or by phone) _____ trips (A trip is any time you leave your home)

If 0 ---> skip to End

Q9 I'd like to ask you about three (adjust number if fewer than three in Q8) of your fishing trips. Let's begin with the first trip you have recorded on your log sheet.

Trip 1 (Your first trip on the log sheet)

Q10a In what month was that trip taken? _____

Q10b What region of Montana were you in during this trip? _____ (Region on logsheet)

Q10c Did you visit more than one river or stream during this trip?

1 Yes —> The next questions pertain to the river on which you fished most of your time.
2 No

Q10d What was the name of this river or stream? _____

Q10e What was the name/nearest landmark of this river or stream? _____

Q10f Can you determine the River Code? Yes —> _____ (Refer to Map and determine if one of our 28 sites. Code = 30 if not one of our sites, Code = 99 if cannot be determined)

Trip 2 (Second log sheet trip - skip if they did not take more than one trip)

Q11a In what month did you take that trip? _____

Q11b What region of Montana were you in during this trip? _____ (Region on logsheet)

Q11c Did you visit more than one river or stream during this trip?

1 Yes —> The next questions pertain to the river on which you predominantly fished.
2 No

Q11d What was the name of this river or stream? _____

Q11e What was the name/nearest landmark of this river or stream? _____

Q11f Can you determine the River Code? Yes —> _____ (Refer to Map and determine if one of our 28 sites. Code = 30 if not one of our sites, Code = 99 if cannot be determined)

Trip 3 (Third log sheet trip - skip if they did not take more than two trips)

Q12a In what month did you take that trip? _____

Q12b What region of Montana were you in during this trip? _____ (Region on logsheet)

Q12c Did you visit more than one river or stream during this trip?

1 Yes —> The next questions pertain to the river on which you predominantly fished.
2 No

Q12d What was the name of this river or stream? _____

Q12e What was the name/nearest landmark of this river or stream? _____

Q12f Can you determine the River Code? Yes ---> _____ (Refer to Map and determine if one of our 28 sites. Code = 30 if not one of our sites, Code = 99 if cannot be determined)

BRANCH II - NO LOGSHEET.

Record information here only if the respondent does not have his or her logsheet.

Q13 How many trips to Montana streams or rivers have you taken since (fill in date last the time s/he was interviewed in person or by phone) _____ trips (A trip is any time you leave your home)

If 0 ---> skip to End

I'd like to ask you about three (adjust number if fewer than three in Q13) of your most recent fishing trips. Let's begin with the last trip you took since we interviewed you by (enter phone or intercept).

Trip 1 (Your most recent trip)

Q14a In what month was that trip taken? _____

Q14b What region of Montana were you in during this trip? _____ (Ask them nearest town or landmark)

Q14c Did you visit more than one river or stream during this trip?

1 Yes ----> The next questions pertain to the river on which you predominantly fished.
2 No

Q10d What was the name of this river or stream? _____ Nearest Landmark? _____

(Interviewer: Refer to Map and determine if one of our 28 sites)

Q10e River Code _____ (Record "30" if not one of our sites, "99" if cannot be determined.)

Trip 2 (Your next most recent trip since you were interviewed)

Q15a In what month was that trip taken? _____

Q15b What region of Montana were you in during this trip? _____ (Ask them nearest town or landmark)

Q15c Did you visit more than one river or stream during this trip?

1 Yes ---> The next questions pertain to the river on which you predominantly fished.

2 No

Q15d What was the name of this river or stream? _____ Nearest Landmark? _____

(Interviewer: Refer to Map and determine if one of our 28 sites)

Q15e River Code _____ (Record "30" if not one of our sites, "99" if cannot be determined)

Trip 3 (Your third most recent trip since you were interviewed)

Q15a In what month was that trip taken? _____

Q15b What region of Montana were you in during this trip? _____ (Ask them nearest town or landmark)

Q15c Did you visit more than one river or stream during this trip?

1 Yes ---> The next questions pertain to the river on which you predominantly fished.
2 No

Q15d What was the name of this river or stream? _____ Nearest Landmark? _____

(Interviewer: Refer to Map and determine if one of our 28 sites)

Q15e River Code _____ (Record "30" if not one of our sites, "99" if cannot be determined)

Thank you for your cooperation with this phone survey. Please recall that we will be contacting you again by phone during the week of _(enter date for next call)_ and in early September by mail.

Q16 Would you like us to send you another logsheet? 1 YES 2 NO

Q17 Do you have any questions or comments at this time?

WESTERN MONTANA FISHING SURVEY
RESPONSE RATE
SPRING 1992 – Phase 1

Wave 1A:	**Total in List**	=106
	Total Number of No Listings	= 11
	Total Number of Completes	= 92
	Total Number of Called but Not Reached	= 3
	Duplicates	= 0
	Total Response Rate (Completes/Eligibles)	= 87%
Wave 2A:	**Total in List**	=111
	Total Number of No Listings	= 5
	Total Number of Completes	= 97
	Total Number of Called but Not Reached	= 6
	Duplicates	= 3
	Total Response Rate (Completes/Eligibles)	= 87%
Wave 3A:		
	Total in List	=111
	Total Number of No Listings	= 9
	Total Number of Completes	= 92
	Total Number of Called but Not Reached	= 10
	Duplicates	= 1
	Total Response Rate (Completes/Eligibles)	= 82%
Wave 4A:	**Total in List**	=107
	Total Number of No Listings	= 5
	Total Number of Completes	= 95
	Total Number of Called but Not Reached	= 7
	Duplicates	= 0
	Total Response Rate (Completes/Eligibles)	= 88%
Wave 5A:	**Total in List**	=108
	Total Number of No Listings	= 1
	Total Number of Completes	= 98
	Total Number of Called but Not Reached	= 9
	Duplicates	= 0
	Total Response Rate (Completes/Eligibles)	= 90%
Wave 6A:	**Total in List**	= 98
	Total Number of No Listings	= 4
	Total Number of Completes	= 83
	Total Number of Called but Not Reached	= 11
	Duplicates	= 0
	Total Response Rate (Completes/Eligibles)	= 85%

Eligibles–Persons qualified to take part in the survey.

Called but not reached–calls were made, but answers were not obtained due to one of the following: answering machine, no answer, busy signal, disconnect, incorrect number listing, duplicate call, refusal, deafness or language impairment, ineligible party, or other.

Social Survey Research Unit
College of Agriculture
University of Idaho

WESTERN MONTANA FISHING SURVEY
RESPONSE RATE
SPRING 1992 – Phase 2

Wave 1B:	**Total in List**	=105
	Total Number of No Listings	= 10
	Total Number of Completes	= 88
	Total Number of Called but Not Reached	= 7
	Duplicates	= 0
	Total Response Rate (Completes/Eligibles)	= 84%
Wave 2B:	**Total in List**	=111
	Total Number of No Listings	= 6
	Total Number of Completes	= 82
	Total Number of Called but Not Reached	= 20
	Duplicates	= 3
	Total Response Rate (Completes/Eligibles)	= 74%
Wave 3B:		
	Total in List	=111
	Total Number of No Listings	= 10
	Total Number of Completes	= 81
	Total Number of Called but Not Reached	= 19
	Duplicates	= 1
	Total Response Rate (Completes/Eligibles)	= 73%
Wave 4B:	**Total in List**	=107
	Total Number of No Listings	= 7
	Total Number of Completes	= 88
	Total Number of Called but Not Reached	= 12
	Duplicates	= 0
	Total Response Rate (Completes/Eligibles)	= 82%

Eligibles–Persons qualified to take part in the survey.

Called but not reached–calls were made, but answers were not obtained due to one of the following: answering machine, no answer, busy signal, disconnect, incorrect number listing, duplicate call, refusal, deafness or language impairment, ineligible party, or other.

Social Survey Research Unit
College of Agriculture
University of Idaho

Appendix 2C
Mail Survey Instruments

Version 1
Version 2
Cover Letters and Reminder Postcard
Telephone Follow-Up Instrument

FISHING IN SOUTHWESTERN MONTANA: FINAL 1992 ANGLER SURVEY

Please return survey to:
Montana Department of Fish, Wildlife, and Parks
Fisheries Division
1420 E. Sixth Ave.
Helena, MT 59620

Version 1

INTRODUCTION

Thank you for participating in this summer's Southwestern Montana River Study. We are asking you to help us one last time. The answers you give will be used to help better manage fishing in Southwestern Montana. For these questions, Southwestern Montana refers to the area on the map enclosed with this survey.

Q1 Overall, how do you rate the quality of fishing in Southwestern Montana? (Circle number of best response.)

VERY POOR ▼ 1 — 2 — 3 — 4 — 5 — 6 — EXCELLENT ▼ 7 DON'T KNOW ▼ 8

Q2 Please provide any suggestions you have to improve fishing in Southwestern Montana.

_____

_____

_____

Q3 When you choose among fishing sites in Southwestern Montana, generally how important is each of the following when making your choice of a particular site? (Circle number of best response for each).

	NOT AT ALL IMPORTANT ▼						VERY IMPORTANT ▼
THE SPECIES OF FISH YOU CAN CATCH	1	2	3	4	5	6	7
THE NUMBER OF FISH YOU THINK YOU WILL CATCH	1	2	3	4	5	6	7
THE SIZE OF THE LARGEST FISH YOU HOPE TO CATCH	1	2	3	4	5	6	7
TO BE ABLE TO FISH IN CATCH & RELEASE WATERS	1	2	3	4	5	6	7
TO BE ABLE TO FISH CLOSE TO YOUR HOME	1	2	3	4	5	6	7
TO BE ABLE TO FISH AT A VERY SCENIC SITE	1	2	3	4	5	6	7
TO AVOID FISHING AT AN UNATTRACTIVE SITE	1	2	3	4	5	6	7
TO FISH AT MANY DIFFERENT SITES	1	2	3	4	5	6	7
TO VISIT SITES THAT ARE ATTRACTIVE IN TERMS OF THE QUALITY OF THE SITE FOR NON-FISHING RECREATION	1	2	3	4	5	6	7

Q4 From unfamiliar (never fished, read about or heard about) to very familiar (often fished, read about or heard about), how familiar are you with each of the following fishing sites? (Circle number of best response for each site.)

	UNFAMILIAR ▼						VERY FAMILIAR ▼
THE BIGHOLE RIVER FROM DIVIDE TO MELROSE (SITE 18 ON YOUR MAP)	1	2	3	4	5	6	7
ROCK CREEK (SITE 5 ON YOUR MAP)	1	2	3	4	5	6	7
THE CLARK FORK RIVER BETWEEN GARRISON JUNCTION AND ROCK CREEK (SITES 2 AND 3 ON YOUR MAP)	1	2	3	4	5	6	7
THE MISSOURI RIVER FROM HOLTER DAM TO DEARBORN RIVER (SITE 22 ON YOUR MAP)	1	2	3	4	5	6	7

Questions 5 through 7 ask for your rating of various characteristics of these four fishing sites. Please rate these sites in comparison to other Southwestern Montana rivers and streams.

Q5 How would you rate each of the sites below in terms of the largest fish you would expect to catch at the site? (Circle number of best response for each site.)

	BELOW AVERAGE ▼					ABOVE AVERAGE ▼	DON'T KNOW ▼
THE BIGHOLE RIVER FROM DIVIDE TO MELROSE (SITE 18 ON YOUR MAP)	1	2	3	4	5	6	7	8
ROCK CREEK (SITE 5 ON YOUR MAP)	1	2	3	4	5	6	7	8
THE CLARK FORK RIVER BETWEEN GARRISON JUNCTION AND ROCK CREEK (SITES 2 AND 3 ON YOUR MAP)	1	2	3	4	5	6	7	8
THE MISSOURI RIVER FROM HOLTER DAM TO DEARBORN RIVER (SITE 22 ON YOUR MAP)	1	2	3	4	5	6	7	8

Q6 How would you rate each of the sites below in terms of the number of fish you would expect to catch in a typical four hours of fishing? (Circle number of the best response for each site.)

	BELOW AVERAGE						ABOVE AVERAGE	DON'T KNOW
	▼						▼	▼
THE BIGHOLE RIVER FROM DIVIDE TO MELROSE (SITE 18 ON YOUR MAP)	1	2	3	4	5	6	7	8
ROCK CREEK (SITE 5 ON YOUR MAP)	1	2	3	4	5	6	7	8
THE CLARK FORK RIVER BETWEEN GARRISON JUNCTION AND ROCK CREEK (SITES 2 AND 3 ON YOUR MAP)	1	2	3	4	5	6	7	8
THE MISSOURI RIVER FROM HOLTER DAM TO DEARBORN RIVER (SITE 22 ON YOUR MAP)	1	2	3	4	5	6	7	8

Q7 How would you rate each of the sites below in terms of the quality of non-fishing recreation activities (hiking, birdwatching, etc.) at the site? (Circle number of the best response for each site.)

	BELOW AVERAGE						ABOVE AVERAGE	DON'T KNOW
	▼						▼	▼
THE BIGHOLE RIVER FROM DIVIDE TO MELROSE (SITE 18 ON YOUR MAP)	1	2	3	4	5	6	7	8
ROCK CREEK (SITE 5 ON YOUR MAP)	1	2	3	4	5	6	7	8
THE CLARK FORK RIVER BETWEEN GARRISON JUNCTION AND ROCK CREEK (SITES 2 AND 3 ON YOUR MAP)	1	2	3	4	5	6	7	8
THE MISSOURI RIVER FROM HOLTER DAM TO DEARBORN RIVER (SITE 22 ON YOUR MAP)	1	2	3	4	5	6	7	8

Q8 Please provide any comments you have on your rankings of the sites in Question 5 through 7 above, especially for the sites you rate as below average.

ABOUT YOUR RECENT TRIPS

Q9 Since we last contacted you on _____, how many trips to all Montana streams or rivers have you taken?

_____ TRIPS ——————> IF ZERO, PLEASE SKIP TO TOP, PAGE 6

Q10 We would like some information on three of your recent trips since we last contacted you.

> If you have used the logsheet we sent to you, please copy the information since our last contact into the table below.

> If you have not kept the log, please complete the table below for the last three trips you have taken to all Montana rivers or streams since we last contacted you.

> Even if you have taken fewer than three trips to Montana sites since we last contacted you, please fill in the table for your trips to Montana sites since we last contacted you.

INFORMATION ON THREE OF YOUR RECENT FISHING TRIPS (See Instructions Above)			
	TRIP ONE	TRIP TWO	TRIP THREE
MONTH TRIP TAKEN			
REGION(S) VISITED (ENTER MISSOULA, HELENA, BUTTE, BOZEMAN OR "OTHER")			
DID YOU FISH AT MORE THAN ONE RIVER OR STREAM? (YES/NO)			
NAME OF PRIMARY SITE VISITED/NEAREST LANDMARK **(ALSO ENTER CODE NUMBER FROM INSERTED MAP IF APPLICABLE)**			
NUMBER OF FAMILY MEMBERS IN YOUR PARTY			
NUMBER OF NON-FAMILY MEMBERS IN YOUR PARTY			

Q11 **Answer the following for your trip recorded in column one of the table on page four.**

a. How many nights were you away from home? . . . . . _____ NIGHTS

b. During this trip did you work on any of the days you fished? (For example, did you fish before or after work?)

1 NO
2 YES ——> ON HOW MANY DAYS DID YOU WORK? ___ DAYS

Continuing with your trip in column one above, if you visited *more than one* site, please answer the following questions just for the primary site you visited (the site where you spent the most time).

c. How many total hours did you spend at the site (fishing and non-fishing)? . . . . . _____ HOURS

d. How many hours did you spend actively fishing? . . . . . _____ HOURS

e. What was the total number of trout you personally caught? . . _____ TROUT

f. How many fish of other species did you personally catch? . . . _____ FISH

g. What types of fish were you trying to catch? (Circle number of best answer.)

1 NO PREFERENCE
2 ANY TYPE OF TROUT
3 RAINBOW TROUT
4 BROWN TROUT
5 OTHER TROUT (PLEASE SPECIFY) _____
6 WHITE FISH
7 OTHER (PLEASE SPECIFY) _____

h. Were any other members of your party primarily involved in non-fishing recreation at this site?

1 NO
2 YES —> NUMBER OF PEOPLE PRIMARILY INVOLVED IN NON-FISHING RECREATION _____ WHAT ACTIVITIES _____ _____

HOW WOULD CHANGES IN FISHING QUALITY AFFECT YOUR FISHING TRIPS?

The next questions concern changing catch rates at two of the sites you rated in Questions 4 - 7. For these questions, assume catch rates change only at the river being discussed. Conditions on all other Montana rivers remain unchanged.

Q12 First consider the Clark Fork River between Garrison Junction and Rock Creek (sites 2 and 3 on your map). Approximately how many fishing trips did you take to this site between May 1st and September 6th of 1992?

_____ TRIPS

Q13 In Q6 you rated your expected catch at this Clark Fork Site. Suppose that a change in management programs at this site increased the number of trout you would expect to catch in a typical 4 hours of fishing.

If you would expect to catch _____ more trout (than you now expect to catch) each 4 hours how would you rate the number of fish you expect to catch at this Clark Fork site as compared to other Southwestern Montana sites? (Circle number of best response.)

BELOW AVERAGE					ABOVE AVERAGE	DON'T KNOW
▼					▼	▼
1	2	3	4	5	6	7	8

Q14 If average catch at this Clark Fork site increased as in Q13, approximately how many more trips in 1992, if any, do you feel you would have taken to this Clark Fork River site? (Enter your best estimate below or write "Don't know".)

_____ ADDITIONAL TRIPS

Q15 If catch increased at this Clark Fork River site, would you still have taken the same number of trips in 1992 to other sites, or would you have fished less at other sites? (Circle number of best answer.)

1 SAME NUMBER OF TRIPS TO OTHER SITES

2 FEWER TRIPS TO OTHER SITES ——————> HOW MANY FEWER TRIPS?___ TRIPS

3 MORE TRIPS TO OTHER SITES ——————> HOW MANY MORE TRIPS?___ TRIPS

8 DON'T KNOW

Q16 Please provide any comments that help explain your answers to questions 13 - 15.

_____

_____

Q17 Now consider the Big Hole River from Melrose to Divide (site 18 on your map). Approximately how many fishing trips did you take to this stretch of the Big Hole between May 1st and September 6th?

_____ TRIPS

Q18 In Q6 you rated your expected catch at this Big Hole site. Suppose that management programs at this Big Hole site changed the number of trout so that you would expect to catch _____ trout than you now expect to catch in a typical 4 hours of fishing.

With this new catch rate, how would you rate the number of fish you expect to catch in a typical four hours of fishing at this Big Hole site as compared to other Southwestern Montana sites?

BELOW AVERAGE						ABOVE AVERAGE	DON'T KNOW
▼						▼	▼
1	2	3	4	5	6	7	8

Q19 If such a change in catch rates had occurred at this Big Hole site, approximately how many more or fewer trips, if any, do you feel you would have taken to this Big Hole site this season? (Circle number of best answer.)

1 SAME NUMBER OF TRIPS TO THE BIG HOLE

2 FEWER TRIPS TO THE BIG HOLE ——> HOW MANY FEWER TRIPS? ____ TRIPS

3 MORE TRIPS TO THE BIG HOLE ——> HOW MANY MORE TRIPS? ____ TRIPS

8 DON'T KNOW

Q20 Would you still have taken the same number of trips to other sites, or would you have fished more or less at other sites this season? (Circle number for best answer.)

1 SAME NUMBER OF TRIPS TO OTHER SITES

2 FEWER TRIPS TO OTHER SITES ——> HOW MANY FEWER TRIPS? ____ TRIPS

3 MORE TRIPS TO OTHER SITES ——> HOW MANY MORE TRIPS? ____ TRIPS

8 DON'T KNOW

Q21 Please provide any comments that help explain your answers to questions 18 - 20.

_____

_____

ABOUT YOU AND YOUR HOUSEHOLD

Your answers to these questions will help us group your response with those of other anglers.

Q22 Including 1992, about how many years have you fished in Montana?

_____ years

Q23 Overall, how would you rate your fishing skills? (Circle best number).

NOVICE EXPERT

1——— 2——— 3——— 4——— 5——— 6———7

Q24 How many people in your household are in the following age groups? (Enter number or zero for each age group).

_____ UNDER 5 YEARS OF AGE
_____ BETWEEN 5 AND 16
_____ BETWEEN 17 AND 20
_____ BETWEEN 21 AND 65
_____ OVER 65 YEARS OLD

Q25 What is the highest level of schooling you completed? (Circle number of best answer.)

1 SOME HIGH SCHOOL OR LESS
2 HIGH SCHOOL GRADUATE
3 SOME COLLEGE, TRADE OR VOCATIONAL SCHOOL
4 TRADE OR VOCATIONAL SCHOOL GRADUATE
5 COLLEGE GRADUATE
6 SOME GRADUATE SCHOOL
7 ADVANCED DEGREE

Q26 How many hours in a typical weekday do you spend in the following activities?

_____HOURS PER DAY SPENT WORKING FOR WAGES OR SALARY

_____HOURS PER DAY SPENT IN HOUSEHOLD CHORES OR CHILDCARE

_____HOURS PER DAY SPENT SLEEPING

_____HOURS PER DAY SPENT IN SCHOOL OR DOING SCHOOL WORK

Q27 How many days do you work in a typical working week?

____ DAYS FULL-TIME

____ DAYS PART-TIME

Q28 If you are employed outside of the home, approximately how many weeks of paid vacation (including holidays) per year do you have?

1 NONE
2 ONE
3 TWO
4 THREE
5 FOUR OR MORE
6 NOT APPLICABLE

Q29 What was your total household income in 1991 before taxes and deductions? Please include all income to this household including social security, interest, dividends from investments, welfare payments, child support, etc. (Circle one number.)

1	UNDER $10,000	6	$40,000 - $49,999	11	$100,000 - $124,999
2	$10,000 - $14,999	7	$50,000 - $59,999	12	$125,000 - $149,999
3	$15,000 - $19,999	8	$60,000 - $69,999	13	$150,000 - $200,000
4	$20,000 - $29,999	9	$70,000 - $79,999	14	MORE THAN $200,000
5	$30,000 - $39,999	10	$80,000 - $99,999	15	CHOOSE NOT TO ANSWER

Q30 If employed outside of the home, please categorize your approximate hourly wage rate.

1	UNDER $5 PER HOUR	5	$15 - $19.99	9	$40 - $49.99
2	$5 - 8.00	6	$20 - $24.99	10	MORE THAN $50 PER HOUR
3	$8 - $11.99	7	$25 - $29.99	11	DOES NOT APPLY
4	$12 - $14.99	8	$30 - $39.99	12	CHOOSE NOT TO ANSWER

Q31 If you worked four more hours per week than you normally do (by taking a second job or working more hours at your principal job), approximately what hourly wage would you expect to earn for each of those four hours?

$ _____ /HOUR

IF YOU ARE A RESIDENT, PLEASE SKIP TO THE BACK PAGE.

ANSWER THE FOLLOWING QUESTIONS ONLY IF YOU ARE NOT A RESIDENT OF MONTANA.

Q32 When you last fished in Montana did you travel to Montana by: (Circle number of best response)

1 AUTOMOBILE
2 AIRPLANE
3 OTHER

What was the approximate round trip airfare from your home to your destination point in Montana?

_____$ AIRFARE

FROM (ENTER ORIGIN CITY) _____

TO (ENTER DESTINATION CITY) _____

What were your expenses for a rental car, if one was used in Montana?

_____$ FOR RENTAL CAR

Q34 Was the primary purpose of this trip to fish in Montana (as opposed to other recreation, work, or for other purposes)?

1 YES
2 NO ——> If No, from which city or town in Montana did your Montana fishing trip start?

ENTER CITY OR TOWN IN MONTANA _____

Please use this space for any comments you might have for the Montana Department of Fish, Wildlife and Parks.

Thank you very much for all of your help this season! We wish you great fishing next year.

V1

FISHING IN SOUTHWESTERN MONTANA: FINAL 1992 ANGLER SURVEY

Please return survey to:
Montana Department of Fish, Wildlife, and Parks
Fisheries Division
1420 E. Sixth Ave.
Helena, MT 59620

Version 2

INTRODUCTION

Thank you for participating in this summer's Southwestern Montana River Study. We are asking you to help us one last time. The answers you give will be used to help better manage fishing in Southwestern Montana. For these questions, Southwestern Montana refers to the area on the map enclosed with this survey.

Q1 Overall, how do you rate the quality of fishing in Southwestern Montana? (Circle number of best response.)

VERY POOR ▼ — 1 — 2 — 3 — 4 — 5 — 6 — 7 ▼ EXCELLENT — DON'T KNOW ▼ 8

Q2 Please provide any suggestions you have to improve fishing in Southwestern Montana.

_____

_____

_____

Q3 When you choose among fishing sites in Southwestern Montana, generally how important is each of the following when making your choice of a particular site? (Circle number of best response for each).

	NOT AT ALL IMPORTANT ▼						VERY IMPORTANT ▼
THE SPECIES OF FISH YOU CAN CATCH	1	2	3	4	5	6	7
THE NUMBER OF FISH YOU THINK YOU WILL CATCH	1	2	3	4	5	6	7
THE SIZE OF THE LARGEST FISH YOU HOPE TO CATCH	1	2	3	4	5	6	7
TO BE ABLE TO FISH IN CATCH & RELEASE WATERS	1	2	3	4	5	6	7
TO BE ABLE TO FISH CLOSE TO YOUR HOME	1	2	3	4	5	6	7
TO BE ABLE TO FISH AT A VERY SCENIC SITE	1	2	3	4	5	6	7
TO AVOID FISHING AT AN UNATTRACTIVE SITE	1	2	3	4	5	6	7
TO FISH AT MANY DIFFERENT SITES	1	2	3	4	5	6	7
TO VISIT SITES THAT ARE ATTRACTIVE IN TERMS OF THE QUALITY OF THE SITE FOR NON-FISHING RECREATION	1	2	3	4	5	6	7

Q4 From unfamiliar (never fished, read about or heard about) to very familiar (often fished, read about or heard about), how familiar are you with each of the following fishing sites? (Circle number of best response for each site.)

	UNFAMILIAR ▼						VERY FAMILIAR ▼
THE BIGHOLE RIVER FROM DIVIDE TO MELROSE (SITE 18 ON YOUR MAP)	1	2	3	4	5	6	7
THE MADISON RIVER FROM LYONS TO VARNEY (SITE 27 ON YOUR MAP)	1	2	3	4	5	6	7
THE CLARK FORK RIVER BETWEEN PERKINS LANE AND GARRISON JUNCTION (SITE 12 ON YOUR MAP)	1	2	3	4	5	6	7
THE JEFFERSON RIVER FROM TWIN BRIDGES TO WATERLOO (SITE 19 ON YOUR MAP)	1	2	3	4	5	6	7

Questions 5 through 7 ask for your rating of various characteristics of these four fishing sites. Please rate these sites in comparison to other Southwestern Montana rivers and streams.

Q5 How would you rate each of the sites below in terms of the <u>largest fish you would expect to catch</u> at the site? (Circle number of best response for each site.)

	BELOW AVERAGE ▼					ABOVE AVERAGE ▼	DON'T KNOW ▼
THE BIGHOLE RIVER FROM DIVIDE TO MELROSE (SITE 18 ON YOUR MAP)	1	2	3	4	5	6	7	8
THE MADISON RIVER FROM LYONS TO VARNEY (SITE 27 ON YOUR MAP)	1	2	3	4	5	6	7	8
THE CLARK FORK RIVER BETWEEN PERKINS LANE AND GARRISON JUNCTION (SITE 12 ON YOUR MAP)	1	2	3	4	5	6	7	8
THE JEFFERSON RIVER FROM TWIN BRIDGES TO WATERLOO (SITE 19 ON YOUR MAP)	1	2	3	4	5	6	7	8

Q6 How would you rate each of the sites below in terms of the number of fish you would expect to catch in a typical four hours of fishing? (Circle number of the best response for each site.)

	BELOW AVERAGE ▼						ABOVE AVERAGE ▼	DON'T KNOW ▼
THE BIGHOLE RIVER FROM DIVIDE TO MELROSE (SITE 18 ON YOUR MAP)	1	2	3	4	5	6	7	8
MADISON RIVER FROM LYONS TO VARNEY (SITE 27 ON YOUR MAP)	1	2	3	4	5	6	7	8
THE CLARK FORK RIVER BETWEEN PERKINS LANE AND GARRISON JUNCTION (SITE 12 ON YOUR MAP)	1	2	3	4	5	6	7	8
THE JEFFERSON RIVER FROM TWIN BRIDGES TO WATERLOO (SITE 19 ON YOUR MAP)	1	2	3	4	5	6	7	8

Q7 How would you rate each of the sites below in terms of the quality of non-fishing recreation activities (hiking, birdwatching, etc.) at the site? (Circle number of the best response for each site.)

	BELOW AVERAGE ▼						ABOVE AVERAGE ▼	DON'T KNOW ▼
THE BIGHOLE RIVER FROM DIVIDE TO MELROSE (SITE 18 ON YOUR MAP)	1	2	3	4	5	6	7	8
THE MADISON RIVER FROM LYONS TO VARNEY (SITE 27 ON YOUR MAP)	1	2	3	4	5	6	7	8
THE CLARK FORK RIVER BETWEEN PERKINS LANE AND GARRISON JUNCTION (SITE 12 ON YOUR MAP)	1	2	3	4	5	6	7	8
THE JEFFERSON RIVER FROM TWIN BRIDGES TO WATERLOO (SITE 19 ON YOUR MAP)	1	2	3	4	5	6	7	8

Q8 Please provide any comments you have on your rankings of the sites in Question 5 through 7 above, especially for the sites you rate as below average.

ABOUT YOUR RECENT TRIPS

Q9 Since we last contacted you on _____, how many trips to all Montana streams or rivers have you taken?

_____ TRIPS ——————> IF ZERO, PLEASE SKIP TO TOP, PAGE 6

Q10 We would like some information on three of your recent trips since we last contacted you.

> If you have used the logsheet we sent to you, please copy the information since our last contact into the table below.

> If you have not kept the log, please complete the table below for the last three trips you have taken to all Montana rivers or streams since we last contacted you.

> Even if you have taken fewer than three trips to Montana sites since we last contacted you, please fill in the table for your trips to Montana sites since we last contacted you.

INFORMATION ON THREE OF YOUR RECENT FISHING TRIPS (See Instructions Above)			
	TRIP ONE	TRIP TWO	TRIP THREE
MONTH TRIP TAKEN			
REGION(S) VISITED (ENTER MISSOULA, HELENA, BUTTE, BOZEMAN OR "OTHER")			
DID YOU FISH AT MORE THAN ONE RIVER OR STREAM? (YES/NO)			
NAME OF PRIMARY SITE VISITED/NEAREST LANDMARK (ALSO ENTER CODE NUMBER FROM INSERTED MAP IF APPLICABLE)			
NUMBER OF FAMILY MEMBERS IN YOUR PARTY			
NUMBER OF NON-FAMILY MEMBERS IN YOUR PARTY			

Q11 **Answer the following for your trip recorded in column one of the table on page four.**

a. How many nights were you away from home? . . . . . _____ NIGHTS

b. During this trip did you work on any of the days you fished? (For example, did you fish before or after work?)

1 NO

2 YES ——→ HOW MANY DAYS DID YOU WORK? ___ DAYS

Continuing with your trip in column one above, if you visited *more than one* site, please answer the following questions just for the primary site you visited (the site where you spent the most time).

c. How many total hours did you spend at the site (fishing and non-fishing)? . . . . . _____ HOURS

d. How many hours did you spend actively fishing? . . . . . _____ HOURS

e. What was the total number of trout you personally caught? . . _____ TROUT

f. How many fish of other species did you personally catch? . . . _____ FISH

g. What types of fish were you trying to catch? (Circle number of best answer.)

1 NO PREFERENCE
2 ANY TYPE OF TROUT
3 RAINBOW TROUT
4 BROWN TROUT
5 OTHER TROUT (PLEASE SPECIFY) _____
6 WHITE FISH
7 OTHER (PLEASE SPECIFY) _____

h. Were any other members of your party primarily involved in non-fishing recreation at this site?

1 NO

2 YES —→ NUMBER OF PEOPLE PRIMARILY INVOLVED IN NON-FISHING RECREATION_____ WHAT ACTIVITIES _____ _____

HOW WOULD CHANGES IN FISHING QUALITY AFFECT YOUR FISHING TRIPS?

The next questions concern changing catch rates at two of the sites you rated in Questions 4 - 7. For these questions, assume catch rates change only at the river being discussed. Conditions on all other Montana rivers remain unchanged.

Q12 First consider the Clark Fork River between Perkins Lane and Garrison Junction (site 12 on your map). Approximately how many fishing trips did you take to this site between May 1st and September 6th of 1992?

_____ TRIPS

Q13 In Q6 you rated your expected catch at this Clark Fork site. Suppose that a change in management programs at this Clark Fork site increased the number of trout you would expect to catch in a typical 4 hours of fishing.

If you would expect to catch _____ more trout (than you now expect to catch) each 4 hours how would you rate the number of fish you expect to catch at this Clark Fork site as compared to other Southwestern Montana sites? (Circle number of best response.)

BELOW AVERAGE						ABOVE AVERAGE	DON'T KNOW
▼						▼	▼
1	2	3	4	5	6	7	8

Q14 If average catch at this Clark Fork site increased as in Q13, approximately how many more trips in 1992, if any, do you feel you would have taken to this Clark Fork River site? (Enter your best estimate below or write "Don't know".)

_____ ADDITIONAL TRIPS

Q15 If catch increased at this Clark Fork River site, would you still have taken the same number of trips in 1992 to other sites, or would you have fished less at other sites? (Circle number of best answer.)

1 SAME NUMBER OF TRIPS TO OTHER SITES

2 FEWER TRIPS TO OTHER SITES ——————> HOW MANY FEWER TRIPS?____ TRIPS

3 MORE TRIPS TO OTHER SITES ——————> HOW MANY MORE TRIPS?____ TRIPS

8 DON'T KNOW

Q16 Please provide any comments that help explain your answers to questions 13 - 15.

_____

_____

Q17 Now consider the Madison River from Lyons to Varney (site 27 on your map). Approximately how many fishing trips did you take to this stretch of the Madison River between May 1st and September 6th?

_____ TRIPS

Q18 In Q6 you rated your expected catch at this Madison River site. Suppose that management programs at this Madison River site changed the number of trout so that you would expect to catch _____ trout than you now expect to catch in a typical 4 hours of fishing.

With this new catch rate, how would you rate the number of fish you expect to catch in a typical four hours of fishing at this Madison River site as compared to other Southwestern Montana sites?

BELOW AVERAGE						ABOVE AVERAGE	DON'T KNOW
▼						▼	▼
1	2	3	4	5	6	7	8

Q19 If such a change in catch rates had occurred at this Madison River site, approximately how many more or fewer trips, if any, do you feel you would have taken to this Madison River site this season? (Circle number of best answer.)

1 SAME NUMBER OF TRIPS TO THE MADISON RIVER

2 FEWER TRIPS TO THE MADISON RIVER ——> HOW MANY FEWER TRIPS? ____ TRIPS

3 MORE TRIPS TO THE MADISON RIVER ——> HOW MANY MORE TRIPS? ____ TRIPS

8 DON'T KNOW

Q20 Would you still have taken the same number of trips to other sites, or would you have fished more or less at other sites this season? (Circle number for best answer below)

1 SAME NUMBER OF TRIPS TO OTHER SITES

2 FEWER TRIPS TO OTHER SITES ——————> HOW MANY FEWER TRIPS? ____ TRIPS

3 MORE TRIPS TO OTHER SITES ——————> HOW MANY MORE TRIPS? ____ TRIPS

8 DON'T KNOW

Q21 Please provide any comments that help explain your answers to questions 18 - 20.

_____

_____

_____

ABOUT YOU AND YOUR HOUSEHOLD

Your answers to these questions will help us group your response with those of other anglers.

Q22 Including 1992, about how many years have you fished in Montana? (Circle number of best answer).

_____ YEARS

Q23 Overall, how would you rate your fishing skills? (Circle best number).

NOVICE ▼						EXPERT ▼
1	2	3	4	5	6	7

Q24 How many people in your household are in the following age groups? (Enter number or zero for each age group).

_____ UNDER 5 YEARS OF AGE
_____ BETWEEN 5 AND 16
_____ BETWEEN 17 AND 20
_____ BETWEEN 21 AND 65
_____ OVER 65 YEARS OLD

Q25 What is the highest level of schooling you completed? (Circle number of best answer.)

1 SOME HIGH SCHOOL OR LESS
2 HIGH SCHOOL GRADUATE
3 SOME COLLEGE, TRADE OR VOCATIONAL SCHOOL
4 TRADE OR VOCATIONAL SCHOOL GRADUATE
5 COLLEGE GRADUATE
6 SOME GRADUATE SCHOOL
7 ADVANCED DEGREE

Q26 How many hours in a typical weekday do you spend in the following activities?

_____HOURS PER DAY SPENT WORKING FOR WAGES OR SALARY

_____HOURS PER DAY SPENT IN HOUSEHOLD CHORES OR CHILDCARE

_____HOURS PER DAY SPENT SLEEPING

_____HOURS PER DAY SPENT IN SCHOOL OR DOING SCHOOL WORK

Q27 How many days do you work in a typical working week?

____ DAYS FULL-TIME

____ DAYS PART-TIME

Q28 If you are employed outside of the home, approximately how many weeks of paid vacation (including holidays) per year do you have?

1 NONE
2 ONE
3 TWO
4 THREE
5 FOUR OR MORE
6 NOT APPLICABLE

Q29 What was your total household income in 1991 before taxes and deductions? Please include all income to this household including social security, interest, dividends from investments, welfare payments, child support, etc. (Circle one number.)

1	UNDER $10,000	6	$40,000 - $49,999	11	$100,000 - $124,999
2	$10,000 - $14,999	7	$50,000 - $59,999	12	$125,000 - $149,999
3	$15,000 - $19,999	8	$60,000 - $69,999	13	$150,000 - $200,000
4	$20,000 - $29,999	9	$70,000 - $79,999	14	MORE THAN $200,000
5	$30,000 - $39,999	10	$80,000 - $99,999	15	CHOOSE NOT TO ANSWER

Q30 If employed outside of the home, please categorize your approximate hourly wage rate.

1	UNDER $5 PER HOUR	5	$15 - $19.99	9	$40 - $49.99
2	$5 - 8.00	6	$20 - $24.99	10	MORE THAN $50 PER HOUR
3	$8 - $11.99	7	$25 - $29.99	11	DOES NOT APPLY
4	$12 - $14.99	8	$30 - $39.99	12	CHOOSE NOT TO ANSWER

Q31 If you worked four more hours per week than you normally do (by taking a second job or working more hours at your principal job), approximately what hourly wage would you expect to earn for each of those four hours?

$ _____ /HOUR

IF YOU ARE A RESIDENT, PLEASE SKIP TO THE BACK PAGE.

ANSWER THE FOLLOWING QUESTIONS ONLY IF YOU ARE NOT A RESIDENT OF MONTANA.

Q32 When you last fished in Montana did you travel to Montana by: (Circle number of best response)

1 AUTOMOBILE
2 AIRPLANE
3 OTHER

What was the approximate round trip airfare from your home to your destination point in Montana?

_____$ AIRFARE

FROM (ENTER ORIGIN CITY) _____

TO (ENTER DESTINATION CITY) _____

What were your expenses for a rental car, if one was used in Montana?

_____$ FOR RENTAL CAR

Q34 Was the primary purpose of this trip to fish in Montana (as opposed to other recreation, work, or for other purposes)?

1 YES
2 NO —> If No, from which city or town in Montana did your Montana fishing trip start?

ENTER CITY OR TOWN IN MONTANA _____

Please use this space for any comments you might have for the Montana Department of Fish, Wildlife and Parks.

Thank you very much for all of your help this season! We wish you great fishing next year.

V2

Montana Department of Fish, Wildlife & Parks

NAME
ADDRESS

September 11, 1992

Dear NAME:

Thank you for participating in this summer's Southwestern Montana River Study. To help the Montana Department of Fish, Wildlife and Parks to improve its understanding and management of Montana's fishery resources, we are asking for your help one last time.

This mail survey asks about your recent fishing activities and about your opinions about the management of fishing activity in Montana. To conserve our resources, you are part of a small group from whom we have collected data earlier this summer. Regardless of whether you fish often or will never fish in Montana again, it is important that we hear from you so that we accurately understand the needs of different anglers using Montana waters and so we can use the information you provided to us earlier this summer.

Your responses are strictly confidential, only general results will be reported, such as "the percent of license holders who fish more than 10 times in a season." The identification number on your questionnaire is there so we can check you name off the mailing list when it is returned, and to match this data with the information you previously provided. The Department of Fish, Wildlife and Parks appreciates your effort to help us do the best job managing Montana fisheries that is possible. As a thank you, we will send you a summary of our results when the study is completed.

Sincerely,

Howard E. Johnson
Chief, Fisheries Management Bureau

September 22, 1992

Recently, a questionnaire was mailed to you seeking information on your recent fishing trips in Montana. Your household is one of only a small number of people being asked to give this information.

If you have already completed and returned your questionnaire to us, please accept our sincere thanks. If not, we ask that you do so today. We are especially grateful for your help. Your responses will be used to help shape future management of the state's rivers and streams.

Sincerely,

Howard Johnson,
Chief, Fisheries Management Bureau

Montana Department of Fish, Wildlife & Parks

NAME
ADDRESS

October 9, 1992

Dear NAME:

Thank you for participating in the Southwestern Montana Rivers study this summer. Your participation will help us to better understand and manage Montana's valuable fishery resources for you and for other anglers like you.

As a final step in this study, three weeks ago I sent a questionnaire about your recent fishing activity and on your opinions about the management of Montana fisheries. As of today, we have not received your completed questionnaire.

I am writing to you again because your participation in this final survey is important to the success of this study. You are a member of a small group of anglers from whom we are collecting data for the entire 1992 fishing season. For the results to truly represent the fishing behavior and opinions of all Montana anglers, it is essential that we receive a completed questionnaire for each person in the sample. Even if you feel you will never again fish in Montana, your opinions will help us manage the resource for other users like you.

Some people have told us particular questions are hard to answer. Management decisions are also hard to make without your input. We are asking you to answer the best you can.

In the event that your questionnaire has been misplaced, a replacement is enclosed. Please return the questionnaire as soon as you can in the return envelope provided. Your assistance is greatly appreciated.

Sincerely,

Howard E. Johnson
Chief, Fisheries Management Bureau

MONTANA FINAL MAIL SURVEY PHONE FOLLOW-UP: PART I

Hello, my name is _____, and I'm working with the State of Montana's Department of Fish, Wildlife and Parks. I'm calling for _____. Is he/she at home? Could I speak with him/her?

IF NO -

Is there a more convenient time when I can call back to reach him/her?

Yes - TIME_____ DAY_____ Thank you. Goodbye.

No - We recently sent (respondent) a survey about fishing in Montana. We are calling to encourage him/her to complete and return it to us. This is the last part of a summer long study. We very much need to have (respondent) complete this last part so the data he/she provided early this summer can be used. Would it be possible for you to remind him/her about the survey?

YES
NO, REFUSE NO, BUSY DECEASED

Thank you. Goodbye.

IF YES-

A couple of weeks ago a survey was sent to you asking about your recent trips to Montana rivers. Did you receive it?

NO - Hearing from you is very important. Could we send you another survey?

NO - Try **. If still NO - Go to part II.
YES - I'll get it in the mail to you right away. Let me verify your address:_____

Thank you for your time. We look forward to hearing from you.

YES, IT HAS BEEN RETURNED - Thank you for your time. Goodbye.

** YES, NOT RETURNED - You are part of a small group of anglers from whom we have been collecting data throughout the 1992 fishing season. This survey is the very last step in the process. For our survey results to accurately represent the opinions of those who fish in Montana, it is important that we receive a completed survey from every person in this sample. Even if you think you will never fish again in Montana, your response is important to the completion of this study. Could I count on you to complete the survey and return it to us as soon as possible?

Yes - Thank you very much.

No - Go to part II.

CODENUM____ GENDER____ LANGUAGE BARRIER? 1 NONE 2 POSSIBLE 3 DEFINITE

PART II.

Q0 It is very important that we understand how those who did not return the survey compare to those who did so we don't misinterpret the results. Could I take just a few minutes of your time to ask you four questions?

1 NO - Thank you. I hope I have not inconvenienced you.
2 YES - Thank you.

Q1 How would you rate your fishing ability on a scale from one to seven with one representing a novice angler and seven an expert

NOVICE 1 2 3 4 5 6 7 EXPERT

Q2 Since we last contacted you on (date of last contact), have you taken any trips to any streams or rivers in Montana?

1 NO - Q3
2 YES - How many trips have you take since (date of last contact)?

_____ TRIPS

I'd like to ask you about your most recent trip:

What month was the trip:_____
What was your primary fishing site:_____ Region:_____
Did you fish at more than one river or stream on this trip:
1 NO
2 YES

Q3 We are asking this next question so that your responses can be categorized with others like yourself. I am going to read off six categories representing different annual household incomes before taxes and deductions. Could you please tell me into which category your household falls:

1 UNDER $10,000
2 $10,000-$40,000
3 $40,000-$60,000
4 $60,000-$100,000
5 $100,000-$200,000
6 GREATER THAN $200,000
7 CHOOSE NOT TO ANSWER

Q4 Please categorize your approximate hourly wage. Again I will read off categories:

1 UNDER $8 PER HOUR
2 BETWEEN $8 AND $15
3 BETWEEN $15 AND $20
4 BETWEEN $20 AND $30
5 BETWEEN $30 AND $40
6 OVER $40
7 DOES NOT APPLY
8 CHOOSE NOT TO ANSWER

WHAT THE RESPONDENT MAY WANT TO KNOW ABOUT THE PHONE FOLLOW-UP SURVEY

Q: Who do you work for?
A: I am representing the Montana Department of Fish, Wildlife and Parks.

Q: Why are you doing this study?
A: To better understand fishing behavior throughout the season in the State of Montana, and ultimately to be able to better manage Montana rivers and streams.

Q: Why are you bothering me again with this survey?
A: We are eventually trying to improve fisheries management in Montana. To do so, we are trying to understand the attitudes and participation levels for a small sample of all different types of Montana anglers. Even if you have taken no fishing trips to Montana rivers and streams since you were last contacted, we need your help on this last piece of the study.

Q: Does this have anything to do with [the mining wastes/ARCO/CF environmental damage/other cases/other issues]?
A: The information from this survey will be available to the Department of Fish, Wildlife and Parks for all of its management activities.

Q: Why did you select me (our household)?
A: You were a member of the intercept group the we contacted this summer.

Q: Why all the information about my household? Why do you need to know income, etc.
A: I can assure you your responses are strictly confidential and are never tied to your name.

Q: They should do... They should not do... (The government, the state, etc.)
A: I will note that on the survey form to make sure it is included. All results will be made available to the Department of Fish, Wildlife and Parks for all of its management activities.

Q: Is this confidential?
A: Yes! Most definitely! All the information we release is in the terms of the percent of respondents that provided certain answers to particular questions. In this form, no individual can ever be identified. Moreover, the matter of confidentiality is terribly important to the success of our work as we do many surveys. Thus we are very careful to protect an individual's anonymity.

Q: Who is sponsoring this survey?
A: The Montana Department of Fish, Wildlife and Parks.

Q: How many people will be participating in the study?
A: You are a member of a group of approximately 1,000 anglers who fished at Montana rivers and streams during the 1992 season.

Appendix 3A
Additional Survey Results

Table 3A-1
Selected Statistics from Intercept Survey

Table 3A-2
Site Destinations of Intercept Trips

Table 3A-3
Summary of Trip Data from the Telephone Survey

Table 3A-4
Selected Statistics from the Mail Survey

Table 3A-5
Comments from the Mail Survey

Table 3A-6
Number of Fishing Trips

Table 3A-7
Proportion of Trips to Each Site and Site Sizes

Table 3A-1
Selected Statistics from Intercept Survey: May 1 - August 23, 1992
(1,951 observations in the sample)

Intercept Survey Question		Mean (standard error of mean)	Total Number of Responses
Set Up Questions			
Percent who took intercept trip in:	May	25.2%	
	June	27.4%	
	July	29.0%	
	August	18.4%	1,951
Percent who were intercepted on a:	Weekday	43.2%	
	Weekend	56.8%	1,933
Rain or bad weather on day of intercept:	No	91.2%	
	Yes	8.8%	1,843
Percent who were intercepted between:	7:30 a.m. - 2:30 p.m.	19.3%	
	11:00 a.m. - 6:00 p.m.	53.0%	
	2:30 p.m. - 9:30 p.m.	27.7%	1,930
Percent of intercepted anglers who are:	Senior	8.5%	
	Adult	83.5%	
	Juvenile	8.0%	1,937
Percent who are male		89.8%	1,931
Percent doing float trip		33.6%	1,911
Percent using a fly rod		56.9%	1,851
Status of angler's trip when intercepted:	Trip complete	29.1%	
	Trip incomplete	40.0%	
	Trip just starting	30.9%	1,893
Survey Questions about Intercept Trip			
Percent who answered at least some questions (Q1)		98%	1,951
Residence status of intercepted anglers (Q2):	Full-time MT resident	59.7%	
	Part-time MT resident	2.8%	
	Nonresident	37.5%	1,906
Primary purpose of living in Montana (part-time residents only) (Q2):	Fish or hunt	33.3%	
	Work	36.1%	
	Other reason	30.6%	72
Percent for whom fishing was primary purpose of intercepted trip (Q3)		77.9%	1,868

Table 3A-1 (cont.)
Selected Statistics from Intercept Survey: May 1 - August 23, 1992
(1,951 observations in the sample)

Intercept Survey Question		Mean (standard error of mean)	Total Number of Responses
Survey Questions about Intercept Trip (cont.)			
Number of large fish caught (Q6): Most anglers did not catch any trout longer than 16 inches. The median number of large trout caught at each of the 26 intensively studied sites is 0.			
Percent who caught other species than trout (Q7)		19.3%	1,645
Survey Questions about Trip Prior to Intercept Trip			
Average number of trips taken prior to intercept trip (Q13)		5.7 (0.927)	1,881
Percent who took trip prior to intercept trip in (Q14):	April	0.4%	
	May	34.1%	
	June	32.5%	
	July	24.7%	
	August	8.2%	939
Percent who visited other site before visiting primary site on this trip (Q15)		30%	1,951
Average number of hours spent fishing at site (Q16)		5.8 (0.415)	956
Average number of trout caught (Q17)		7.2 (0.511)	956
Median number of large trout caught (Q18)		0	889
About the Angler			
Median age (Q19)		38	1,898
Percent employed (Q20):	Full-time	62.6%	
	Part-time	6.6%	1,949
Percent in wage per hour categories (Q21):	Less than $10	30.7%	
	Between $10 and $20	38.8%	
	Greater than $20	30.5%	1,510
Percent on vacation during intercept trip (Q22)		42.2%	1,812
Percent who had previously been intercepted (Q23)		6.0%	1,863
Note: Anglers who had already taken the survey once were not followed up twice.			

Table 3A-2
Site Destinations of Intercept Trips

	Residents	Nonresidents	Total
Number of intercept trips	1,236 (63% of all trips)	715 (37% of all trips)	1,951 (100%)
Number of intercept trips to single site	1,107 (90% of all resident trips)	373 (52% of all nonresident trips)	1,480 (76% of all trips)
Number of intercept trips to multiple sites	129 (10% of all resident trips)	342 (48% of all nonresident trips)	471 (24% of all trips)
% of multiple-site trips to a single region	84% of all resident multiple-site trips	53% of all nonresident multiple-site trips	62% of all multiple-site trips

Table 3A-3
Summary of Trip Data from the Telephone Survey

	Phase 1 (first telephone call)	Phase 2 (second telephone call)
Total successful contacts	556	339
Percent who took no trips since date of last contact	43.3%	57.2%
Percent who took at least one trip since date of last contact	56.6%	42.8%
Percent who took at least two trips since date of last contact	43.0%	31.6%
Percent who took three or more trips since date of last contact	34.3%	24.2%

Table 3A-4
Selected Statistics from the Mail Survey
(505 observations in the sample)

Mail Survey Question	Mean (standard error of mean)	Number of Responses
Average rating of quality of Montana fishing: 1 = *very poor*, 7 = *excellent* (Q1)	5.18 (0.056)	474
Comments (Q2): Of the 505 respondents to the mail survey, 372 provided at least one written comment. A total of 1,063 comments were made. All mail survey comments are summarized in Table 3A-7 in this appendix.		
Average number of trips since date of last contact (Q9)	2.95 (0.261)	505
Information on three recent trips (Q10):		
Percent who took:		
At least one trip	50.9%	
At least two trips	41.8%	
Three or more trips	35.0%	505
Questions relating to one trip documented on mail survey (Q11):		
Average number of nights away from home for:		
Residents	1.04 (0.185)	212
Nonresidents	17.0 (3.954)	56
Full sample	4.38 (0.923)	268
Median number of nights away from home for:		
Residents	0	212
Nonresidents	7.5	56
Full sample	0	268
Percent who worked on days they fished	19.8%	263
Average number of days for those who worked	1.85 (0.368)	66
Average total hours spent at the primary site	24.63 (3.537)	243
Average total hours actively fishing at the primary site	10.37 (1.344)	246
Average number of trout caught at the primary site	12.31 (1.561)	245
Average number of other species caught at primary site	3.06 (0.380)	244
Percent fishing for:		
Any type of trout	53.9%	
Rainbow trout only	10.9%	
Brown trout only	9.4%	
No preference	9.0%	
Whitefish or other	16.8%	256

Table 3A-4 (cont.)
Selected Statistics from the Mail Survey
(505 observations in the sample)

Mail Survey Question	Mean (standard error of mean)	Number of Responses
Questions relating to one trip documented on mail survey (Q11) (cont.):		
Percent of parties with members engaged in nonfishing recreation	22.0%	255
Average number of years respondents have fished in Montana (Q22):		
Residents	18.63 (0.772)	300
Nonresidents	9.06 (0.725)	191
Average self-assessed skill rating: 1 = *novice*, 7 = *expert* (Q23):		
Residents	4.86 (0.077)	305
Nonresidents	4.79 (0.095)	194
Average number of people in household (Q24):		
Under age 5	0.21 (0.023)	
Ages 5 - 16	0.56 (0.043)	
Ages 17 - 20	0.13 (0.019)	
Ages 21 - 65	1.75 (0.040)	
Over age 65	0.17 (0.023)	480
Percent who graduated from college (Q25):	52.5%	489
Average number of hours per day respondents spend (Q26):		
Working for wages	6.99 (0.181)	
Doing household chores or child care	2.08 (0.103)	
Sleeping	7.00 (0.081)	
In school or studying	0.64 (0.097)	486
Average number of days per week respondents spend (Q27):		
Working full-time	3.99 (0.100)	
Working part-time	0.42 (0.059)	431
Average number of weeks of paid vacation per year (Q28): (includes all who responded)		
0 - 1	46.0%	
2 - 3	24.9%	
4 and up	29.1%	457

Table 3A-4 (cont.)
Selected Statistics from the Mail Survey
(505 observations in the sample)

Mail Survey Question	Mean (standard error of mean)	Number of Responses
Average income for (Q29):		
Residents	$41,006 (1,847)	256
Nonresidents	$81,672 (4,160)	169
Average hourly wage for (Q30):		
Residents	$15.67 (0.686)	178
Nonresidents	$27.94 (1.378)	108
Average expected wage per hour for (Q31):		
Residents	$15.16 (0.969)	179
Nonresidents	$31.26 (3.984)	94
Percent of nonresidents who travelled by (Q32):		
Automobile	66.1%	
Airplane	29.5%	224
Other	4.5%	
Median airfare for nonresidents who flew (Q32)	$365.00	58
Origin cities of nonresidents who flew (Q32). 40 cities in 19 different states and Canadian provinces were reported.		
Destination cities of nonresidents who flew (Q32). The Montana city into which the greatest percentage of nonresidents flew is Bozeman. The second most popular destination was Missoula.		
Median car rental for nonresidents who flew (Q32)	$325.00	46

Table 3A-5
Comments from the Mail Survey

Comment	Times Made
Environmental/Fish, Wildlife and Parks (FWP) Comments	
Someone should monitor and control industrial polluters	5
Someone should monitor and control agricultural polluters	20
FWP or other environmental manager is doing a good job	29
FWP or other environmental manager needs to strengthen its role	27
Stop fish kills resulting from pollution	1
Reduce anglers' pollution	2
Limit development around river	1
Provide more fishing information to anglers	1
Miscellaneous environmental/FWP comments	49
Stock and Number of Fish Comments	
Increase stocking/want more fish	32
Increase stock fish size	7
Stock "my" area more	1
Miscellaneous stock comments	15
Catch and Release/Size Limits	
Increase number of catch and release rivers	80
Reduce the catch limit	19
Increase the catch limit	1
Flies and lures areas only (no live bait)	18
No barbed lures or flies	10
Reduce unnecessary killing of fish by anglers	7
Set slot limits on size	18
Miscellaneous about catch, catch limits, size limits	24

Table 3A-5 (cont.)
Comments from the Mail Survey

Comment	Times Made
Regulations/Enforcement Issues	
Restrict fishing season	11
Enforce current catch limits more effectively	10
Enforce current license laws more effectively	9
Do not raise fees; they are just right	1
Reduce number of allowable river outfitters and guides/charge outfitters more	35
Charge out-of-staters more/limit number of out-of-staters	5
Miscellaneous regulations/enforcement comments	18
Access Issues	
Improve access to rivers	31
More handicapped/elderly access	3
Improve or add facilities	13
Access to more sites	39
Miscellaneous access comments	16
Site Comments	
Big Hole 2 is an excellent site	1
Missouri is an excellent site	1
Upper Clark Fork is an excellent site	1
Madison 2 is a excellent site	1
Rock Creek is an excellent site	2
Big Hole 2 is an average site	1
Big Hole 2 is a poor site	5
Missouri is a poor site	4
Upper Clark Fork is a poor site	3
Madison 2 is a poor site	2
Jefferson 2 is a poor site	1

Table 3A-5 (cont.)
Comments from the Mail Survey

Comment	Times Made
Site Comments (cont.)	
Rock Creek is decreasing in quality	2
Miscellaneous site comments	48
Survey Comments	
Good job on survey, glad I could help	29
Survey is waste of time/money	3
Would be interested in results, please send	2
Questions are inappropriate	2
Improve survey by shortening	1
Miscellaneous comments about the survey	3
Flow Comments/Regulation of Flow	
Reduce drainage of rivers and streams by agriculture/industry	37
General — flow is too low	34
Miscellaneous flow comments	18
Miscellaneous Recurring Comments	
Everything is just right/do not change anything	7
Rivers congested by anglers	15
Fishing is poor this year	6
Fishing is good this year	23
Do not know enough/cannot comment	45
Allow only bank fishing	11
See gradual decline in Montana fishing	6
Montana becoming too expensive	3
Increase length of fishing season	3
Reduce/ban number of motorized boats	3
Other miscellaneous comments	181

Table 3A-6
Number of River and Stream Fishing Trips in Montana Taken by Sample Anglers
May - September 1992

	Mean	Median	Number of Observations
Residents	17.88	13.00	291
Nonresidents	3.82	2.00	152

Table 3A-7
Proportion of Trips to Each Site and Site Sizes
(proportion of trips to 26 sites)

River	Full Sample (N = 443)	
	Proportion of Trips	Size = Flow × Length
UCF 1	0.026	31,787
UCF 2	0.011	14,404
UCF 3	0.004	10,526
Middle CF	0.049	125,175
Rock Cr.	0.065	21,240
Flint Cr.	0.013	940
Bitterroot 1	0.038	69,975
Bitterroot 2	0.074	32,714
Lolo Cr.	0.012	2,400
Blackfoot	0.026	64,543
L. Blackfoot	0.017	3,030
UCF 4	0.007	6,840
UCF 5	0.015	456
Silver Bow Cr.	0.001	1,134
WSC	0.003	490
Big Hole 1	0.057	40,509
Big Hole 2	0.061	25,077
Jefferson 2	0.038	46,721
Beaverhead	0.049	7,020
Jefferson 1	0.017	46,721
Missouri	0.145	49,311
Yellowstone	0.038	116,662
Gallatin	0.040	33,218
E. Gallatin	0.024	1,120
Madison 1	0.058	18,216
Madison 2	0.113	46,255

Appendix 3B

The Number of Anglers and Number of Trips

The Total Number of Anglers Active in Stream Fishing in Southwestern Montana

The total number of Montana resident anglers was derived using all-season licenses and 75 percent of multipurpose licenses that allow fishing (R. McFarland, MT Dept. of Fish, Wildlife and Parks, pers. comm.). The multipurpose categories that allow fishing include the sportsman license, the disabled conservation license, and the *pioneer* license.[1] In 1991, this results in a total of 204,123 resident anglers. We assume the same number of resident and nonresident anglers in 1992 as in 1991.

Nonresident anglers can purchase either a season fishing license or one or more two-day licenses. The State of Montana Department of Fish, Wildlife and Parks reports that, on average, nonresidents who purchase two-day licenses buy two per year (R. McFarland, pers. comm.). To calculate the total number of nonresident anglers, all-season licenses are added to half of the two-day licenses sold. Also included are 30 percent of nonresident multipurpose licenses, which include big game and deer combination licenses that allow fishing (R. McFarland, pers. comm.). In 1991 (and 1992), this results in a total of 109,696 nonresident anglers.

Next, we require an estimate of the number of anglers who are active in river and stream fishing in southwestern Montana. According to a recent statewide survey that can be segregated by county, at least 42.7 percent of resident license holders purchased licenses in southwestern Montana (McFarland and Brooks, 1993). It is highly likely that licenses purchased in the area are associated with fishing in the area. However, many anglers purchasing licenses in other areas of the state are also likely to fish in southwestern Montana. Therefore, we believe 45 percent is a conservative estimate of the percentage of licensed anglers in the state who fish in southwestern Montana. Additionally, 77.5 percent of resident anglers in southwestern Montana prefer to fish streams or to fish both lakes and streams (McFarland and Brooks, 1993). These statistics imply that about 34.9 percent (45 percent multiplied by 77.5 percent) of all resident anglers are active in river and stream fishing in southwestern Montana. Therefore, we estimate there were 71,239 (204,123 multiplied by 34.9 percent) resident anglers active in river and stream fishing in southwestern Montana in 1992.

Comparable figures on where licenses were purchased and fishing preferences for streams are not available for nonresidents who fish in Montana. Consequently, we compute the percent of nonresident Montana anglers who are active at southwestern Montana rivers and streams based on the resident statistics discussed above and fishing pressure statistics for residents and

[1] The pioneer license allows people 12-14 years of age and over 62 to fish. Pioneer licenses have been a subset of resident conservation licenses since 1976. Before that year, they were a separate category. Forty-eight percent of conservation licenses are pioneer licenses. Forty-eight percent is a three-year average over 1989, 1991, and 1992. Therefore, 75 percent times 48 percent of resident conservation licenses are counted as relevant pioneer anglers.

nonresidents. Salmonid rivers and streams in Montana Wildlife Regions 2 and 3, which are included in our study area, receive 23.3 percent of all fishing pressure (in days) in Montana for residents and 39.7 percent of all fishing pressure for nonresidents (McFarland, 1989; McFarland, 1992).[2] Southwestern Montana also includes a portion of Region 4 and a small portion of Region 1. These parts of Regions 1 and 4 make up approximately 20 percent of southwestern Montana. We increase the Regions 2 and 3 pressure estimates by 25 percent to account for the portions of Regions 1 and 4 in southwestern Montana[3] and estimate that 29.1 percent of all resident fishing pressure in the state and 49.7 percent of all nonresident fishing pressure in the state is at salmonid streams in southwestern Montana.

These pressure figures understate the percent of active anglers in the region as, for example, anglers active in the region might only take half of their trips in the region or they might spend half of their time fishing on lakes. If anglers took half of their trips to rivers and streams in southwestern Montana, pressure proportions would understate the percent of anglers active in the region by about 50 percent. To use the pressure figures to estimate the percentage of nonresident anglers active at rivers and streams in southwestern Montana, we multiply the nonresident pressure estimate by the ratio of the percent of resident anglers who are active in river and stream fishing in southwestern Montana to the pressure percentage for residents (34.9 percent/29.1 percent = 1.2), or 1.2 times the 49.7 percent of nonresident statewide fishing pressure at rivers in the study area, which equals 59.5 percent of nonresident anglers active in the study area. For 1992, we estimate there were 65,313 (109,696 times 59.5 percent) nonresident anglers active in river and stream fishing in southwestern Montana.

Table 3B-1 shows the number of resident and nonresident anglers active in river and stream fishing in southwestern Montana from 1949 to 1992 estimated similarly; these figures show that the number of anglers has changed little, especially since 1980.

The Mean Number of Stream Trips Taken by Anglers Active in Stream Fishing in Southwestern Montana

The Montana state volume of the 1991 National Survey of Fishing, Hunting and Wildlife-Associated Recreation is the source for average angler trip statistics because it reports the only data available on average number of trips taken by the population of Montana anglers (U.S. DOI, 1993).[4] Unpublished 1991 National Survey data show that the average resident

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[2] *Salmonid* rivers and streams are cold water and provide habitat for trout. All of our 26 intensively studied sites are salmonid rivers and streams, as are the great majority of the rivers and streams in southwestern Montana. These figures were calculated as a five-year average for 1982 through 1985 and 1989.

[3] 1.25 = 1/(1 - 20%).

[4] All other data report use in fishing days instead of trips. Our data are in terms of fishing trips.

Table 3B-1
Estimated Number of Anglers Who Fish at Rivers and Streams in Southwestern Montana (1949-1992)

Year	Resident Anglers	Nonresident Anglers
1992	71,239	65,313
1991	71,239	65,313
1990	71,885	61,521
1989	70,841	58,338
1988	71,509	54,902
1987	75,396	54,699
1986	76,468	52,629
1985	77,623	56,100
1984	78,095	54,043
1983	78,452	62,371
1982	77,677	63,808
1981	75,771	53,537
1980	75,413	45,309
1979	72,383	47,772
1978	70,391	46,187
1977	68,016	46,187
1976	66,478	43,459
1975	62,139	41,217
1974	62,793	39,465
1973	62,136	49,598
1972	58,880	48,593
1971	56,491	43,208
1970	56,335	43,088
1969	56,179	42,968
1968	56,023	42,850
1967	55,868	42,731
1966	55,713	42,613
1965	55,559	42,495

Table 3B-1 (cont.)
Estimated Number of Anglers Who Fish at Rivers and Streams in Southwestern Montana (1949-1992)

Year	Resident Anglers	Nonresident Anglers
1964	55,405	42,377
1963	55,252	42,260
1962	55,099	42,143
1961	54,947	42,026
1960	54,794	41,910
1959	54,076	41,360
1958	53,366	40,818
1957	52,667	40,282
1956	51,976	39,754
1955	51,294	39,233
1954	50,621	38,718
1953	49,958	38,210
1952	49,302	37,709
1951	48,655	37,214
1950	48,018	36,727
1949	47,388	36,245

angler who fishes rivers and streams in Montana takes 11.49 trips per year (R. Aiken, U.S. Fish and Wildlife Service, pers. comm.).

The 1991 National Survey also reports 301,000 nonresident trips and 178,000 nonresident anglers for 1991, indicating approximately 1.7 trips per angler. However, we feel this estimate is marginally too low (most nonresident river fishing occurs in Southwestern Montana, but these figures are for the entire state). The estimate of 178,000 nonresident anglers is higher than the estimate of 110,000 nonresident anglers based on license data. License data show that the large majority of nonresident anglers (over 70 percent) fish with two-day licenses. The Montana Department of Fish, Wildlife and Parks reports that the typical two-day license buyer buys two two-day licenses per year (R. McFarland, pers. comm.). Adjusting the estimate for this reduces the National Survey estimate to 100,000 nonresident anglers, which is similar to the estimate of 110,000 based on the license data. Assuming the average two-day license buyer (who buys two two-day licenses per year) takes 1.5 trips (half take one trip and half take two trips), we calculate that the National Survey overestimates the number of trips by

117,000. Adjusting for this, an accurate figure for the average number of trips per year taken by nonresidents is 1.84. This reflects the expectation that season license holders take more trips than do purchasers of two-day licenses.

The National Survey estimates of the average number of fishing trips include trips to both lakes and streams. The National Survey averages can be adjusted downward for river fishing versus all fishing. The percentage of trips taken by the population of resident anglers who are active in river and stream fishing in our region can be estimated using the fishing preference percentage discussed above. Assuming that those who prefer both streams and lakes fish one-half of their trips at each, it is estimated that 76.8 percent of resident anglers' trips are to rivers and streams.[5] We assume the same adjustment applies to nonresidents. The National Survey estimates of the average number of total trips is multiplied by this percentage to calculate the average annual number of river and stream trips. These are 8.83 trips (11.49 × 76.8 percent) for residents and 1.41 trips (1.84 × 76.8 percent) for nonresidents. Using these averages and the numbers of anglers reported above, it is estimated that residents anglers active in river and stream fishing in southwestern Montana took 628,855 river fishing trips in Montana in 1992, and nonresidents took 92,295 trips.

An additional adjustment can be made to calculate the mean number of trips that occur during the summer season. Approximately 72 percent of resident salmonid stream fishing pressure in our region and 95 percent of nonresident pressure occurs from May through September (McFarland, 1989; McFarland, 1992). Making this adjustment yields an average of 6.36 summer stream trips for the population of resident anglers and 1.34 summer stream trips for nonresidents.

References

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[5] 41.5 percent prefer rivers and 36 percent prefer both. (41.5/77.5 + 18/77.5) = 76.8 percent of trips are to rivers and streams.

Appendix 4A
The Recreation Demand Model of Participation, Site Choice, and Expected Catch Rates

The Travel-Cost Component of the Model: A Repeated Nested-Logit Model of Participation and Site Choice

Assume that the fishing season can be divided into 60 periods such that in each period the individual can take at most one fishing trip. In each period the individual decides both whether and where to fish. The individual will choose the alternative that provides the greatest utility. The utility the individual receives during period p if he chooses alternative j is:

(1) $U_{jp} = V_j + \varepsilon_{jp}$; j = 0, UCF1, UCF2, UCF3, MCF, RC, FC, BT1, BT2, LC, BF, LBF, RMo, UCF4, UCF5, SBC, WSC, BH1, BH2, J2, BV, J1, RBUo, MS, RHo, LY, G, EG, MD1, MD2, RBZo, R5

where j = 0 is the nonfishing alternative and UCF1 - LBF, UCF4 - J1, MS, and LY - MD1 are abbreviations for the 26 intensively studied sites in the four regions (see Table 2-1). The sites in the Missoula region, RM, are UCF1, UCF2, UCF3, MCF, RC, FC, BT1, BT2, LC, BF, LBF, and RMo, where RMo is a collective of all the other sites in the Missoula region. The Butte region, RBU, is UCF4, UCF5, SBC, WSC, BH1, BH2, J2, BV, J1, and RBUo. The Helena region, RH, has just two sites, MS and RHo, and the Bozeman region, RBZ, is LY, G, EG, MD1, MD2, and RBZo. R5 is a collective of all the river and stream sites in Montana that are not in one of the four regions in southwestern Montana, denoted region 5.

The term V_j depends on the cost and characteristics of alternative j and is deterministic from both the individual's and the researcher's perspective. Alternatively, ε_{jp} is known to the individual, but varies from period to period, across individuals and across sites in a way the researcher cannot observe. Therefore ε_{jp} and U_{jp} are random variables from the researcher's perspective.

Assume the ε_{jp} are drawn from the generalized extreme value distribution with distribution function:

$$(2)\quad F(\epsilon) = \exp[-e^{-\epsilon_0} - [(E_M)^{t/s} + (E_{BU})^{t/s} + (E_H)^{t/s} + (E_{BZ})^{t/s} + (E_5)^{t/s}]^{1/t}]$$

where s is a statistical parameter that measures the degree of unobserved correlation between the utility from trips to any two sites in the same region, t is a statistical parameter that measures the degree of unobserved correlation between the utility from trips to any two fishing sites,[1] and:

$$(3)\quad E_M = e^{s\epsilon_{UCF1}} + e^{s\epsilon_{UCF2}} + e^{s\epsilon_{UCF3}} + e^{s\epsilon_{MCF}} + e^{s\epsilon_{RC}} + e^{s\epsilon_{FC}} + e^{s\epsilon_{BT1}} + e^{s\epsilon_{BT2}} + e^{s\epsilon_{LC}} + e^{s\epsilon_{BF}} + e^{s\epsilon_{LBF}} + e^{s\epsilon_{RMo}}$$

[1] A sufficient, but not necessary, condition for this density function to be well-behaved is $s \geq t \geq 1$. This condition is fulfilled (see Table 5C-1).

$$(4)\quad E_{BU} = e^{s\epsilon_{UCF4}} + e^{s\epsilon_{UCF5}} + e^{s\epsilon_{SBC}} + e^{s\epsilon_{WSC}} + e^{s\epsilon_{BH1}} + e^{s\epsilon_{BH2}} + e^{s\epsilon_{J2}} + e^{s\epsilon_{BV}} + e^{s\epsilon_{J1}} + e^{s\epsilon_{RBUo}}$$

$$(5)\quad E_{H} = e^{s\epsilon_{MS}} + e^{s\epsilon_{RHo}}$$

$$(6)\quad E_{BZ} = e^{s\epsilon_{LY}} + e^{s\epsilon_{G}} + e^{s\epsilon_{EG}} + e^{s\epsilon_{MD1}} + e^{s\epsilon_{MD2}} + e^{s\epsilon_{RBZo}}$$

$$(7)\quad E_{RS} = e^{s\epsilon_{RS}}$$

The variable t reflects common characteristics of rivers and streams in Montana that are not included as explicit variables in the model, so t is a determinant of how many trips one takes to rivers and streams in Montana. The variable s reflects common characteristics of fishing sites in the same region that are not included as explicit variables in the model, so s is a determinant of the allocation of trips across regions.

This generalized extreme value function, equation (2), generates a three-level nested logit model of participation and site choice.

Given this Cumulative Density Function (CDF), the per-period probability that an individual will choose not to fish is:

$$(8)\quad Prob_0 = \frac{e^{V_0}}{e^{V_0} + [(I_M)^{t/s} + (I_{BU})^{t/s} + (I_H)^{t/s} + (I_{BZ})^{t/s} + (I_{RS})^{t/s}]^{1/t}}$$

where:

$$(9)\quad I_M = e^{sV_{UCF1}} + e^{sV_{UCF2}} + e^{sV_{UCF3}} + e^{sV_{MCF}} + e^{sV_{RC}} + e^{sV_{FC}} + e^{sV_{BT1}} + e^{sV_{BT2}} + e^{sV_{LC}} + e^{sV_{BF}} + e^{sV_{LBF}} + e^{sV_{RMo}}$$

$$(10)\quad I_{BU} = e^{sV_{UCF4}} + e^{sV_{UCF5}} + e^{sV_{SBC}} + e^{sV_{WSC}} + e^{sV_{BH1}} + e^{sV_{BH2}} + e^{sV_{J2}} + e^{sV_{BV}} + e^{sV_{J1}} + e^{sV_{RBUo}}$$

$$(11)\quad I_H = e^{sV_{MS}} + e^{sV_{RHo}}$$

$$(12)\quad I_{BZ} = e^{sV_{LY}} + e^{sV_{G}} + e^{sV_{EG}} + e^{sV_{MD1}} + e^{sV_{MD2}} + e^{sV_{RBZo}}$$

$$(13)\quad I_{RS} = e^{sV_{RS}}$$

The per-period probability the individual will choose site j in the Missoula region (j = UCF1, UCF2, UCF3, MCF, RC, FC, BT1, BT2, LC, BF, LBF, RMo) is:

$$(14)\quad Prob_j = \frac{e^{sV_j}[(I_M)^{t/s}+(I_{BU})^{t/s}+(I_H)^{t/s}+(I_{BZ})^{t/s}+(I_{R5})^{t/s}]^{(1/t)-1}\ (I_M)^{(t/s)-1}}{e^{V_0}+[(I_M)^{t/s}+(I_{BU})^{t/s}+(I_H)^{t/s}+(I_{BZ})^{t/s}+(I_{R5})^{t/s}]^{1/t}}$$

The per-period probability the individual will choose site j in the Butte Region (j = UCF4, UCF5, SBC, WSC, BH1, BH2, J2, BV, J1, RBUo) is:

$$(15)\quad Prob_j = \frac{e^{sV_j}[(I_M)^{t/s}+(I_{BU})^{t/s}+(I_H)^{t/s}+(I_{BZ})^{t/s}+(I_{R5})^{t/s}]^{(1/t)-1}\ (I_{BU})^{(t/s)-1}}{e^{V_0}+[(I_M)^{t/s}+(I_{BU})^{t/s}+(I_H)^{t/s}+(I_{BZ})^{t/s}+(I_{R5})^{t/s}]^{1/t}}$$

The per-period probability the individual will choose site j in the Helena Region (j = MS, RHo) is:

$$(16)\quad Prob_j = \frac{e^{sV_j}[(I_M)^{t/s}+(I_{BU})^{t/s}+(I_H)^{t/s}+(I_{BZ})^{t/s}+(I_{R5})^{t/s}]^{(1/t)-1}\ (I_H)^{(t/s)-1}}{e^{V_0}+[(I_M)^{t/s}+(I_{BU})^{t/s}+(I_H)^{t/s}+(I_{BZ})^{t/s}+(I_{R5})^{t/s}]^{1/t}}$$

The per-period probability the individual will choose site j in the Bozeman Region (j = LY, G, EG, MD1, MD2, RBZo) is:

$$(17)\quad Prob_j = \frac{e^{sV_j}[(I_M)^{t/s}+(I_{BU})^{t/s}+(I_H)^{t/s}+(I_{BZ})^{t/s}+(I_{R5})^{t/s}]^{(1/t)-1}\ (I_{BZ})^{(t/s)-1}}{e^{V_0}+[(I_M)^{t/s}+(I_{BU})^{t/s}+(I_H)^{t/s}+(I_{BZ})^{t/s}+(I_{R5})^{t/s}]^{1/t}}$$

And, the per-period probability the individual will choose a site in Montana that is in region 5 (not in one of the four regions in southwestern Montana) is:

$$(18)\quad Prob_{R5} = \frac{e^{sV_{R5}}[(I_M)^{t/s}+(I_{BU})^{t/s}+(I_H)^{t/s}+(I_{BZ})^{t/s}+(I_{R5})^{t/s}]^{(1/t)-1}\ (I_{R5})^{(t/s)-1}}{e^{V_0}+[(I_M)^{t/s}+(I_{BU})^{t/s}+(I_H)^{t/s}+(I_{BZ})^{t/s}+(I_{R5})^{t/s}]^{1/t}}$$

Specifically, assume the V_j for a fishing trip to site j, where j is one of the 26 intensively studied sites, is a function of the following variables: the angler's cost of a trip to site j, $COST_j$; the expected catch rate at site j, ECR_j; the size of site j, SZ_j; the angler's per-period income, PPY; a variable that takes the value one if there is a campground adjacent to the site and zero otherwise, D_{CG}; a variable that takes the value one if the river has low flow but is suitable for float fishing (only the Beaverhead) and zero otherwise, D_{LFF}; a variable that takes the value one if the site is high flow but is unsuitable for float fishing (only the Gallatin) and zero otherwise, D_{HFNF}; a variable that takes the value one if the site has limited bank access and is unsuitable for float fishing (only Upper Clark Fork 3) and zero otherwise, D_{LIMA}; and a

variable that takes the value one if the site is exceptionally ugly (only Silver Bow Creek) and zero otherwise, D_U.

$$
\begin{aligned}
V_j = {} & [\beta_0(1 - NRES) + \beta_{ONR}(NRES)](PPY - COST_j) \\
& + [\beta_C + \beta_{CRSK}(1 - NRES) + B_{CNR}(NRES)](ECR_j) \\
& + \beta_{SZ}(SZ_j) + \beta_{CG}(D_{CG}) + \beta_{LFF}(D_{LFF}) \\
& + \beta_{HFNF}(D_{HFNF}) + \beta_U(D_U) + \beta_{LIMA}(D_{LIMA})
\end{aligned} \tag{19}
$$

where NRES = 1 if the angler is not a resident of Montana and zero if the angler is a resident. Note (PPY - $COST_j$) is the amount of money the individual has left to spend on other goods in period t if the individual takes a trip to site j.[2]

If the trip is to a site in one of the four regions (Missoula, Butte, Helena, or Bozeman), but not to one of the intensively-studied sites, assume:

$$V_j = [\beta_0(1 - NRES) + \beta_{0NR}(NRES)](PPY - AveCOST_{Rk}) + \alpha_O \tag{20}$$

where the individual's cost of a trip to the *collective* site in region k is assumed to be the average of the individual's trip costs for the intensively studied sites in region k. Since the collective sites are catch-alls for trips to sites other than the intensively studied sites, there is unobserved variation across trips to each collective site in terms of site size and expected catch rate. Therefore, size and expected catch rate cannot be included as explicit determinants of the utility an angler receives from a trip to a collective site. Their influence is replaced with a constant term, α_O.

If the trip is to a site that is not in one of the four explicit regions in southwestern Montana, assume:

$$V_{R5} = [\beta_0(1 - NRES) + \beta_{0NR}(NRES)](PPY) + \alpha_{R5} \tag{21}$$

Note in this case there is no information about trip costs, so even though trip cost is positive it cannot be included as an explicit determinant of the utility the angler receives from a trip to this *fifth* region. Its influence must be accounted for by the fifth-region constant, α_{R5}.

If an individual does not take a fishing trip in period t, that individual will have PPY to spend on other goods and V_0 is:

[2] Looking ahead, the estimated values of D_U and D_{LIMA} are not significantly different from zero, indicating the uniqueness of Silver Bow Creek in terms of attractiveness and the uniqueness of Upper Clark Fork 3 in terms of access are not significant determinants of participation and site choice.

$$(22) \quad V_0 = [\beta_0(1 - NRES) + \beta_{0NR}(NRES)](PPY) + \beta_G(G) + \beta_{SK}(SK) + \beta_{MTF}(MTF) + \beta_{FT}(FT) + \beta_A(A) + \beta_V(V) + \beta_{PNR}(NRES) + \alpha_P$$

where G is the angler's gender (1 = female), SK is self-assessed fishing skill, MTF is years fished in Montana, FT is reported hours of free time in a typical weekday, A is age,[3] V is weeks of paid vacation, and α_P is a constant term.

While each angler's utility is an increasing function of his or her income, the choice probabilities are not a function of income because an increase in income affects the utility from all of the alternatives equally.

The Catch Component of the Model

Define x_{kj} as the reported catch for intercept trip k to site j and define h_{kj} as the number of hours of fishing associated with that catch. Assume that catch has a Poisson distribution such that the probability of catching x_{kj} fish in h_{kj} hours of fishing is:[4]

$$(23) \quad Prob(x_{kj}) = \frac{\exp(-h_{kj}ECR_j)(h_{kj}ECR_j)^{x_{kj}}}{x_{kj}!} \quad ; j = 1, \ldots, 25$$

$$x_{kj} = 0, 1, 2, \ldots .$$

This Poisson distribution correctly restricts the observed catch to be a nonnegative integer and is consistent with the large number of observations with zero catch.

Expected catch rates are the link between the catch rate and travel-cost components of the model in that they are parameters in both components.

The log likelihood function for this joint model is reported in Appendix 5B.

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[3] In early stages of the analysis, a linear model was estimated that regressed anglers' total number of trips on various demographic variables to help us to decide which variables to include in equation (22). AGE^2 was considered but was not statistically significant and led to a decrease in the adjusted R^2. Consequently, AGE^2 was not included in the recreation demand model.

[4] The ECR for Silver Bow Creek is zero, as there are no trout (see Section 1.2.2). The expected catch rate for Madison 2 was normalized to its simple Poisson average catch rate (0.726). Madison 2 is the site with the most recorded fishing time (see Section 4.2.2). This anchors the expected catch rates for the other 24 sites on the zero expected catch rate for Silver Bow Creek and the simple Poisson average for Madison 2.

Appendix 5A
Calculation of Trip Costs

Resident Trip Costs

The cost of a trip to site j by a resident of Montana is (round trip distance from the individual's residence to site j) multiplied by (per-angler, per-mile vehicle operating costs) + (average lodging expenses by one-way distance category) + (average equipment expenses by one-way distance category) + [(travel and on-site time) multiplied by (the opportunity cost of the individual's free time)].

Distances were calculated using the shortest possible routes on interstate highways and major roads.

Average resident costs for lodging, equipment, and on-site time for a trip were determined for each of four distance categories. The one-way distances from each point of origin to each site were grouped into categories of 0-25 miles, 26-50 miles, 51-150 miles, and greater than 150 miles. Average lodging expenses and equipment expenses by distance category are in Table 3-7.

For the purpose of the recreation demand model, interviewees who stated they are part-time residents on the intercept survey were treated as residents. Distances from part-time residents' Montana homes were calculated from the city or town in Montana identified in Q2 on the intercept survey.

According to the Montana Department of Labor and Industry, the state government of Montana paid its employees $0.275 per mile in 1992 to drive their own cars for job-related activities. The federal government allowed a tax deduction of $0.28 per mile for vehicle operating expenses incurred for work related activities (U.S. Internal Revenue Service, 1992). To be conservative, we used $0.275 divided by two for two anglers per car as our per-mile vehicle operating expense.[1]

For residents, travel time is the round trip distance divided by 45, where 45 m.p.h. is the assumed average travel speed for trips by Montana residents to our 26 intensively studied sites and was chosen based on study-team members' and survey agents' visits to the sites. Average on-site time by distance category is in Table 3-6.

The per-hour opportunity cost of each individual's free time (for residents and nonresidents) is assumed to be his or her wage rate multiplied by some fraction, β_W, where β_W is an estimated parameter in the model.

[1] The postcard data show that the median number of anglers in a fishing party is two, for both resident and nonresident fishing parties.

Nonresident Trip Costs

Nonresidents were separated into two groups: those for whom the cheapest method to travel to Montana is to fly and those for whom the cheapest method is to drive. Transportation costs for nonresidents were calculated using the cheapest method of travel. For nearby states such as Idaho, the costs of travelling by car are cheaper than by plane. For more distant states such as New York, it is cheaper to travel by plane. In Q32 on the mail survey, nonresidents were asked to report the airfare and car rental fees they paid when they travelled to Montana on their last trip if they flew. The data indicate average airfare and car rental rates do not vary much across states or national regions. The median airfare is $365.00, and the median car rental fee is $325.00. Adding the two costs together yields $690.00. Using the vehicle operating expense of $0.275 per mile, an individual can drive approximately 2,500 miles for $690.00.

For nonresidents within a 1,250 mile radius from Butte, costs were measured using driving expenses. For all nonresidents beyond the 1,250 mile limit, costs were calculated using plane and car rental expenses which are less than driving costs. States (and Canadian provinces) within the 1,250 mile limit include Alberta, California, Colorado, Idaho, Minnesota, New Mexico, Nevada, Oregon, Saskatchewan, Utah, Washington, and Wyoming. Nonresidents outside the limit came from Alaska, Arizona, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Kansas, Louisiana, Massachusetts, Maryland, Michigan, Missouri, North Carolina, New Hampshire, New Jersey, New York, Oklahoma, Pennsylvania, Texas, Vermont, and Wisconsin.

Distances for driving nonresidents were calculated by first measuring the distance from nonresidents' homes to the nearest zip code in Montana for which we had calculated residents' distances. The distances to all of the sites from those zip codes were subsequently added.

The cost of a trip to site j for a driving nonresident is (round trip distance from the individual's residence to site j) multiplied by (per-angler, per-mile vehicle operating costs) + (average lodging expenses for nonresidents) + (average equipment expenses for nonresidents) + [(travel time and average on-site time for nonresidents) multiplied by (the opportunity cost of the individual's time)].

The time spent on a fishing trip to site j for a driving nonresident includes the total travelling time to site j assuming an average speed of 60 m.p.h. outside of Montana and 45 m.p.h. once the nonresident angler reaches the Montana zip code from which he or she travels to site j. Average on-site time for nonresidents is reported in Table 3-6.

The cost of a trip to site j for a nonresident who resides more than 1,250 miles from Butte is the (median airfare for sample who flew) + (median car rental payment for sample who flew divided by two anglers per car) + (average lodging expenses for nonresidents) + (average

equipment expenses for nonresidents) + [(travel time and average on-site time for nonresidents) multiplied by (the opportunity cost of the individual's time)].

The travel time for flying has two components:

1. The average two-way air time and stopover time for airplane flights from the city with an airport nearest to the nonresident's home to Bozeman or Missoula, whichever is closest to the site. These are the two most popular flight destinations as reported in the mail survey.

2. The two-way time to get to each of the 26 sites from Bozeman or Missoula.

Reference

U.S. Internal Revenue Service. 1992. Cumulative Bulletin, Vol. 2.

Appendix 5B
The Likelihood Function

The Log Likelihood Function for the Recreation Demand Model

For each of the 443 anglers in the recreation demand data set, there is a record of how many fishing trips he or she took during the 1992 summer season, but not a complete record of where each angler went for each trip.

An angler's fishing trips were allocated to one of the following 36 site categories on the basis of the information available for each trip:

T_{UCF1} ,T_{UCF2} , ...,T_{LBF} = Number of trips to each of the 11 intensively studied sites in the Missoula region (UCF1, UCF2, UCF3, MCF, RC, FC, BT1, BT2, LC, BF, LBF)

T_{RMo} = Number of trips that were to single sites in the Missoula region that are not intensively studied sites

T_{RM} = Number of trips where each trip involved multiple sites in the Missoula region but no sites in other regions

T_{UCF4} ,T_{UCF5} , ...,T_{J1} = Number of trips to each of the nine intensively studied sites in the Butte region (UCF4, UCF5, SBC, WSC, BH1, BH2, J2, BV, J1)

T_{RBUo} = Number of trips that were to single sites in the Butte region that are not intensively studied sites

T_{RBU} = Number of trips where each trip involved multiple sites in the Butte region but no sites in other regions

T_{MS} = Number of trips to the intensively studied Missouri site in the Helena region (MS)

T_{RHo} = Number of trips that were to single sites in the Helena region that are not the intensively studied stretch of the Missouri

T_{RH} = Number of trips where each trip involved multiple sites in the Helena region but no sites in other regions

T_{LY} ,T_{G} , ...,T_{MD2} = Number of trips to each of the five intensively studied sites in the Bozeman region (LY, G, EG, MD1, MD2)

T_{RBZo} = Number of trips that were to single sites in the Bozeman region that are not intensively studied sites

T_{RBZ} = Number of trips where each trip involved multiple sites in the Bozeman region but no sites in other regions

T_{R5} = Number of trips to rivers or streams in Montana that are not in the Missoula, Butte, Helena, or Bozeman regions

T_O = Number of trips where each trip involved multiple regions or where there is no information about the site or sites visited except that each trip involved river or stream fishing in Montana.

The number of periods the individual chose not to fish, N, is 60 minus the individual's total number of fishing trips.

The per-period probability of nonparticipation ($Prob_0$), the per-period probabilities associated with the four region-specific collective sites for southwestern Montana ($Prob_{RMo}$, ..., $Prob_{RBZo}$), the per-period probability of choosing a site in another part of Montana ($Prob_{R5}$), and the per-period probabilities for the 26 intensively studied sites ($Prob_{UCF1}$, $Prob_{UCF2}$, ..., $Prob_{MD2}$) are all defined in Appendix 4A. The per-period probability of a trip to multiple sites in region k (k = M, BU, H, BZ) is modelled as the per-period probability that region k will be chosen. Denote this per-period probability $Prob_{Rk}$. For example, $Prob_{RM}$ is the per-period probability the Missoula region will be chosen where $Prob_{RM} = Prob_{UCF1} + Prob_{UCF2} + ... + Prob_{LBF} + Prob_{RMo}$.

Let $w_f = (1 - NRES)w_f^r + NRES \times w_f^{nr}$ be the weight for a fishing trip, unique to residents or nonresidents, where w_f^r equals the ratio of the mean number of trips in the population to the mean number of trips in the sample for residents for the summer season (see also Appendix 3B and Table 3A-6): $w_f^r = 6.355722/17.87973 = 0.355471$, and w_f^{nr} is the same ratio for nonresidents: $w_f^{nr} = 1.342464/3.815789 = 0.351818$. The dichotomous variable NRES is equal to one for a nonresident and zero for a resident. Let $w_{nf} = (1 - NRES)w_{nf}^r + NRES \times w_{nf}^{nr}$ be the weight for nonparticipation, also unique to residents or nonresidents, where w_{nf}^r equals the ratio of the mean number of periods of nonparticipation in the population to the mean number of periods of nonparticipation in the sample for residents: $w_f^r = (60 - 6.355722)/(60 - 17.87973) = 1.273598$, and w_{nf}^{nr} is the same ratio for nonresidents: $w_{nf}^{nr} = (60 - 1.342464)/(60 - 3.815789) = 1.044022$.

The log likelihood function for the travel-cost component of the model is:

$$(1) \quad L_{tc} = \sum_{i=1}^{443} [w_{nf} \times N \times \ln(Prob_0) + w_f\{T_O\ln(Prob_O) + T_{RS}\ln(Prob_{RS}) + T_{RM}\ln(Prob_{RM}) + T_{RBU}\ln(Prob_{RBU}) + T_{RH}\ln(Prob_{RH}) + T_{RBZ}\ln(Prob_{RBZ}) + T_{RMo}\ln(Prob_{RMo}) + T_{RBUo}\ln(Prob_{RBUo}) + T_{RHo}\ln(Prob_{RHo}) + T_{RBZo}\ln(Prob_{RBZo}) + \sum_{j=1}^{26} T_j\ln(Prob_j)\}]$$

where the T variables, and all the probabilities (Prob) are indexed by i; the i subscript is suppressed for notational simplicity. This component of the log likelihood function is a function of all parameters in the model, the data on site characteristics, and the data for each of the 443 anglers on trips, trip costs, gender, age, residency, skill, years fished in Montana, free time, and weeks of paid vacation. The parameters include the expected catch rates.

In addition to the travel-cost data, for each of 1,344 intercepted anglers there are data on number of fish caught and hours fished. Let x_{kj} denote reported catch of intercept trip k at site j, and let h_{kj} denote the corresponding hours of fishing. Catch data were collected from intercepted anglers at each of the 26 intensively studied sites except for Silver Bow Creek, where no one was intercepted and there are no fish. This information and the assumption that catch has a Poisson distribution (see equation 23, Appendix 4A) adds the following term to the log likelihood function:

$$(2) \quad L_c = \sum_{j=1}^{25} \sum_{k=1}^{K_j} [-h_{kj}ECR_j + x_{kj}\ln(h_{kj}ECR_j) - \ln(x_{kj}!)]$$

where K_j is the number of intercept trips to site j with catch information.

The log likelihood for the joint model of participation, site choice, and expected catch rates is $L = L_{tc} + L_c$.

Appendix 5C
Parameter Estimates

Table 5C-1
Parameter Estimates

Parameter		Estimate	t Statistic
Expected catch rates	ECUCF1	0.434	6.967
	ECUCF2	0.222	2.941
	ECUCF3	0.423	4.783
	ECMCF	0.447	8.883
	ECRC	0.926	20.598
	ECFC	0.877	9.268
	ECBT1	0.240	5.546
	ECBT2	0.739	14.833
	ECLC	0.683	8.698
	ECBF	0.267	6.203
	ECLBF	0.731	5.244
	ECUCF4	0.846	7.660
	ECUCF5	0.784	8.851
	ECWSC	0.771	5.429
	ECBH1	0.899	17.930
	ECBH2	0.812	14.428
	ECJ2	0.326	7.696
	ECBV	0.637	17.164
	ECJ1	0.280	6.994
	ECMS	0.760	17.577
	ECLY	0.382	11.238
	ECG	0.884	11.481
	ECEG	1.051	11.184
	ECMD1	0.413	11.602
	ECMD2	0.7260	---
Parameters explaining the influence of the expected catch rates	β_{ECR}	0.126	1.581
	β_{ECRNR}	0.246	2.218
	β_{CRSK}	2.604E-2	1.633

Table 5C-1 (cont.)
Parameter Estimates

Parameter		Estimate	t Statistic
Parameters explaining the influence of trip costs	β_0	7.224E-3	3.739
	β_{0NR}	6.150E-4	3.819
	β_W	0.110	3.479
Parameters explaining the influence of gender, age, skill, years fished in Montana, free time, vacation, and residency	α_P	4.414	23.203
	β_G	0.239	2.349
	β_A	5.20E-3	2.565
	β_{SK}	-0.480	-20.029
	β_{MTF}	2.380E-2	10.412
	β_{FT}	-0.040	-5.997
	β_V	0.093	5.927
	β_{PNR}	1.840	19.758
Parameters explaining the influence of size, campgrounds, and suitability for floating	β_{SZ}	0.213	3.207
	β_{CG}	0.131	3.368
	β_{LFF}	0.100	2.151
	β_{HFNF}	-0.168	-2.782
Other parameters	α_O	0.431	3.270
	α_{R5}	-0.052	-0.878
	s	53.691	1.862
	t	2.957	7.179

Appendix 6A
Calculation of Trout Stocks

Table 6A-1
Calculation of Mile-Weighted Average Current and Baseline Stock Estimates*

Angling Site	Reach*	State Type*	Length (river miles)*	Total Length (river miles)**	Current Stock (trout/HA)*	Miles-Weighted Average Current Stock (trout/HA)	Baseline Stock (trout/HA)*	Miles-Weighted Average Baseline Stock (trout/HA)
UCF 1	1	7/3	2.5	15.6	34.5	63.82	78.2	146.85
	1	4/5	3.8		38.0		212.5	
	1	3/5	9.4		81.9		138.4	
UCF 2	2	4	5.0	35.1	6.5	7.14	100.1	107.62
	2	3	1.4		29.9		93.2	
	2	4	20.2		6.5		100.1	
	2	2/3	1.4		4.5		248.1	
	2	4	2.4		6.5		100.1	
	3	4	4.1		4.3		126.8	
	3	3	0.5		7.0		34.1	
UCF 3	4	3	14.8	27.4	11.6	13.78	31.2	40.80
	4	4	0.5		5.8		45.5	
	4	3	1.8		11.6		31.2	
	4	4	1.6		5.8		45.5	
	5	4	8.8		19.8		57.8	
UCF 4	6	2d	2.7	31.3	10.1	119.98	988.1	780.33
	6	4	2.1		20.6		215.1	
	6	3/4	4.7		20.6		215.1	
	6	2d	5.0		10.1		988.1	
	6	4	2.5		20.6		215.1	
	6	2d	2.9		10.1		988.1	
	6	2u	5.5		2.1		1,689.1	
	6	1/2	5.9		583.7		453.6	
UCF 5	6	1/2	2.0	2.0	583.7	583.70	453.6	453.60

Table 6A-1 (cont.)
Calculation of Mile-Weighted Average Current and Baseline Stock Estimates*

Angling Site	Reach*	State Type*	Length (river miles)*	Total Length (river miles)**	Current Stock (trout/HA)*	Miles-Weighted Average Current Stock (trout/HA)	Baseline Stock (trout/HA)*	Miles-Weighted Average Baseline Stock (trout/HA)
Silver Bow Cr.	7	6	3.8	28.5	0	0.00	41.6	113.75
	7	2	1.1		0		41.6	
	7	4/6	0.4		0		10.9	
	7	6	2.9		0		41.6	
	7	4/6	3.5		0		10.9	
	7	6	0.5		0		41.6	
	9	4/6	3.3		0		441.8	
	10	4/6	1.4		0		107.1	
	10	3/6	3.6		0		107.1	
	10	4/6	6.5		0		107.1	
	10	4	1.6		0		107.1	
Rock Cr.[1]	1	3	0.2	9.4	178.9	206.22	Rock Creek and Big Hole 1 are reference streams	
	1	2	1.8		227.2			
	1	3	5.3		193.1			
	1	10	2.1		224.1			
Big Hole 1[2]	5	3	0.7	16.9	50.3	38.02		
	5	3/9	10.2		41.2			
	4	10	2.5		26.4			
	1	3/9	3.4		34.2			

* Don Chapman Consultants, Inc. 1995. Assessment of Injury to Fish Populations: Clark Fork River NPL Sites, Montana (Chapter 6 to Lipton et al., 1995a). Prepared for the State of Montana, Natural Resource Damage Litigation Program. October.

** Total length reflects the length of stream for which stock estimates were made or extrapolated.

1 Stock estimates for Rock Creek correspond to the portion of the site in this study from 10.4 river miles from the confluence to 1 river mile from the confluence.

2 Stock estimates for Big Hole 1 correspond to the portion of the site in this study from 28.8 river miles from the confluence to 8.1 river miles from the confluence.

Appendix 7A
Derivation of WTP and WTA

Derivation of WTP and WTA for the Baseline Expected Catch Rates at the Clark Fork River and Silver Bow Creek

The details of the recreation demand model are presented in Appendix 4A. This appendix only explains the derivation of WTP and WTA from the model. Variables and parameters not defined here were defined in Appendix 4A.

Define per-period expected maximum utility as:

(1) $V = V(PPY, COST, ECR, SZ, D_{CG}, D_{LFF}, D_{HFNF}, NRES, G, SK, MTF, FT, A, V)$

where $COST$, ECR, SZ, D_{CG}, D_{LFF}, and D_{HFNF} are each 26 × 1 vectors with one element for each of the 26 intensively studied sites; for example:

$$COST \equiv COST(COST_{UCF1}, COST_{UCF2}, \ldots, COST_{MD2}).$$

Given the specification of the recreation demand model, per period expected maximum utility is:

(2) $$V = \ln\{e^{V_0} + [(I_M)^{t/s} + (I_{BU})^{t/s} + (I_H)^{t/s} + (I_{BZ})^{t/s} + (I_{RO})^{t/s}]^{1/t}\} + 0.57$$

where 0.57 is Euler's constant.

Define ECR^O as the expected catch rates that currently exist at the 26 sites given the injuries at the Clark Fork River and Silver Bow Creek. Define ECR' as the expected catch rates that would exist at the 26 sites if there were no injuries to the Clark Fork River and Silver Bow Creek.

Therefore, expected maximum utility, given the current injury level expected catch rates, is:

(3) $V^O = V(PPY, ECR^O, \Gamma)$

where Γ denotes all of the other variables that determine expected maximum utility.

And, expected maximum utility in the absence of injuries is:

(4) $V' = V(PPY, ECR', \Gamma)$.

An individual's per-period willingness to pay for the baseline expected catch rates, WTP_p, is the amount of money that makes maximum utility with baseline expected catch rates and that amount subtracted from income equal to maximum utility with the current expected catch rates. That is, WTP_p is the maximum the individual would pay per period to experience the baseline expected catch rates.

It follows that for residents an individual's expected willingness to pay for the baseline stocks is:

$$(5) \qquad WTP_p = \left[\frac{1}{\beta_0}\right] [V^1 - V^0]$$

and that for nonresidents it is:

$$(6) \qquad WTP_p = \left[\frac{1}{\beta_{0NR}}\right] [V^1 - V^0].$$

An individual's per-period willingness to accept the current expected catch rates rather than the baseline expected catch rates, WTA_p, is the amount the individual would have to be paid to voluntarily accept the current injury-level expected catch rates. Given the specification of the model, $WTA_p = WTP_p$.

Total WTP for the summer season is obtained by multiplying WTP_p by 60, the number of periods. Since the summer accounts for 72 percent of resident salmonid stream fishing pressure in southwestern Montana, and 95 percent of nonresident fishing pressure, we obtain estimates of annual WTP and WTA by dividing the summer estimates by these percentages.

Appendix 8A
1992 Recreational Boating Survey

1992 RECREATIONAL BOATER USE SURVEY FOR NON-ANGLERS

INTERVIEWER CODE _____ RIVER CODE _____
SITE OF INTERVIEW _____ MONTH/DAY _____

Circle Type of Watercraft:

Raft	Drift/John Boat	Kayak	Other_____
Inner tube	Canoe	Motorboat	(Please specify)

Hello, my name is _____. I'm conducting a floating use survey for the MT Dept. of Fish, Wildlife, and Parks. It would help us in the management of this river if I could ask you a few questions about your float trip. May we have your help? 1 No 2 Yes >> Continue

R1 Are you a full-time or part-time resident of Montana, or a non-resident?

1 FULL-TIME RESIDENT – County of Residence _____
2 PART-TIME RESIDENT (owns or rents in MT) – Nearest City/Town _____
3 NON-RESIDENT ↓
State of Residence (if part-time or Non-resident)_____

R2 At what location did you put in your craft? _____(nearest landmark)

R3 At what location will you take out? _____ _____(nearest landmark)

R4 Was this a commercial or private trip? Circle one: Private Commercial

R5 Was floating the primary purpose of your trip? _____
(A "trip" is any time you leave home or your part-time residence).

R6 What were other recreational activities you participated in along the river on this trip?
Please check all that apply:

Birdwatching	____	Camping	____	Gold Panning	____
Hiking	____	Peak Climbing	____	Picnicking	____
Rock Climbing	____	Rock Collecting	____	Swimming	____
Wildlife Viewing	____	Other (Please list)	_____		

To better manage this and other rivers in Montana, we may want to contact you by mail or phone to find out more about your float trip. The follow-up will only take a small amount of your time. Would you be willing to help us by giving your name and address?

1 Yes >>

NAME_____
ADDRESS_____
CITY_____STATE___ZIP_____
PHONE_____

2 No

Thank you for participating in our study!

Appendix 8B
Economic Valuation of Nonfishing Recreation

State of Montana
Natural Resource Damage Program

Prepared by:

John Duffield

Bioeconomics, Inc.
Missoula, MT

The valuation of nonfishing recreation impacts uses the considerable literature on nonfishing recreational use values to select unit values to be applied to the change in nonfishing recreation trips to the sites under baseline conditions. The unit value methodology may be used under both the current and proposed NRDA regulations: "Unit values are preassigned dollar values for various types of nonmarketed recreational or other experiences by the public. Where feasible, unit values in the region of the affected resource and unit values that closely resemble the recreation or other experience lost with the affected resource may be used." [43 CFR § 11.83 (c)(2)(vi)].

In this section, the literature on nonfishing recreation is reviewed to identify an appropriate unit value. One perspective on this issue is to examine the relative magnitude of nonfishing recreational use values compared to fishing recreational use values. Selecting a unit value is somewhat complicated by the mix of different nonfishing recreation activities, each with different net economic values, that would occur along the upper Clark Fork River and Silver Bow Creek under baseline conditions, and because the reported values vary across different studies in different locations. Therefore, the strategy employed here is to select an average value that conservatively reflects the values reported for the applicable recreation activities.

Hagmann (1979) identified the types of nonfishing activities taking place in the upper Clark Fork River and tributaries in 1978 (see Table 8-2). These included floating, walking, picnicking, sightseeing, camping, water play, hunting, and gathering berries and mushrooms. Similarly, the 1992 boating intercept survey (see Table 8-5) found that floaters also enjoyed birdwatching, camping, hiking, picnicking, swimming, and wildlife viewing. Average net benefits per day or per visit have been estimated for many of these nonfishing recreation activities in Montana and throughout the Rocky Mountain West. Both Walsh et al. (1988) and Smith and Kaoru (1990) have compiled and summarized such estimates. Estimates from these sources for the Rocky Mountain West for the types of recreation activities that have been impacted along the Clark Fork River and Silver Bow Creek corridors are summarized in Table 8B-1. These estimates apply to each recreation day and have been updated to 1992 dollars. The listed studies show values from $10.52 for picnicking to $100.22 for waterfowl hunting, but average around $37.00.

The 17 studies listed in Table 8B-1 are for nonfishing recreation valuation studies undertaken in Montana and the Rocky Mountain West. Table 8B-2 provides a more comprehensive summary of 181 nonfishing recreation studies undertaken throughout the United States from Walsh et al. (1988). This summary of studies, like the studies limited to Montana and the Rocky Mountain West, shows that activities like camping, picnicking, swimming, sightseeing, and hiking are valued somewhat less per day than floating or hunting. For comparison purposes, Table 8B-2 also reports an average value for cold water fishing. The lesser valued nonfishing recreation activities average 60 percent to 70 percent of the value of cold water fishing, while hunting and floating activities have a value roughly equivalent to or exceeding the value of fishing.

Table 8B-1
Literature-Based Average Net Benefits per Day for Recreational Activities Other than Fishing as Summarized by Walsh et al. (1988) and Smith and Kaoru (1990)

Authors (Date)/State	Activity and Method**	Avg. Net Benefits per Day (S 1992)*
Brown and Plummer (1979)/Washington	Hiking/Hedonic	$21.58
Walsh and Olienyk (1981)/Colorado	Hiking/On-site CVM	$16.08
Rosenthal and Walsh (1986)/Colorado	Hiking/On-site CVM	$29.97
Walsh and Olienyk (1981)/Colorado	Picnicking/On-site CVM	$10.52
Walsh et al. (1980)/Colorado	Picnicking/Open-ended CVM	$21.87
Michaelson (1977)/Idaho	Rafting/Individual TCM	$35.74
Walsh et al. (1980)/Colorado	Rafting/Open-ended CVM	$21.96
Young et al. (1987)/Idaho	Small game hunting/Open-ended CVM	$30.87
Brown and Plummer (1979)/Idaho	Small game/Hedonic	$49.19
Duffield and Neher (1991)/Montana	Waterfowl hunting/DC — CVM	$100.22
Duffield (1988)/Montana	Elk hunting/TCM standard cost	$31.70
Duffield (1988)/Montana	Elk hunting/TCM reported cost	$83.61
Loomis et al. (1988)/Montana	Elk hunting/DC — CVM	$51.07
Brooks (1988)/Montana	Deer hunting/Regional TCM	$64.81
Loomis (1988)/California	Viewing deer/CVM	$19.98
Markstrom and Rosenthal (1987)/Colorado	Gathering wood/Zonal TCM	$19.74
Daniels (1987)/Montana	Camping/Zonal TCM	$23.94

* Net benefits per day are the average for the study sample if calculated as such. In some cases, the study did not estimate net benefits on a per-day basis. In these cases, the net benefits are those derived from the estimates in the studies by Walsh et al. (1988).

** CVM = contingent valuation method; TCM = travel cost method; DC = dichotomous choice.

Table 8B-2
Net Economic Values per Day Reported by TCM and CVM Demand Studies from 1968 to 1988 Applied to National Forest Recreation Use Categories, United States ($ 1992)

Activity	Number of Estimates	Mean	Median
Camping	18	$23.96	$23.25
Picnicking	7	$21.30	$15.75
Swimming	11	$28.22	$22.86
Sightseeing	6	$24.93	$24.23
Hiking	6	$35.74	$29.02
Boating, nonmotorized	11	$59.82	$31.16
Hunting	83	$51.23	$42.86
Cold water fishing	39	$37.62	$35.01

Source: Walsh et al., 1988.

McCollum et al. (1990) report net economic values for nonfishing recreation at national forests and for a region including Montana, Idaho, and South Dakota, which are presented in Table 8B-3. These estimates are based on a 1985-1986 Public Area Recreation Visitor Survey, a nationwide project by the Forest Service and other federal agencies. The Clark Fork River and Silver Bow Creek are not in a national forest, but the estimates are for similar activities in the region. These estimates are similar to those in Table 8B-1, but are on a per-visit basis. The central estimates range from $17 for sightseeing to $37 for wildlife observation. McCollum's estimate for cold water fishing is included for comparison purposes. The simple average of the nonfishing activities is $21 for the low estimates, $31 for the central estimates, and $36 for the high estimates. These average values are from 70 percent to 100 percent of the estimated value of a cold water fishing visit in this region. McCollum et al. note that their estimates are not adjusted for the proximity of substitute sites. However, the authors conclude that the values reported are conservative estimates of net benefits of the reported recreation activities because of analytical assumptions made. Again, these estimates are for each recreation visit.

Table 8B-3
Net Economic Values per Visit for Recreation Activities in National Forests: Montana, Idaho, and South Dakota

Activity Type	Value per Person Trips ($ 1992)		
	Low	Central	High
Developed camping	$22.09	$34.62	$38.69
Wildlife observation	$33.70	$36.90	$40.10
Day hiking	$25.14	$37.84	$44.66
Picnicking	$22.90	$28.68	$32.24
Sightseeing	$3.28	$17.38	$26.61
Cold water fishing	$30.41	$35.42	$37.00

Source: McCollum et al., 1990. Table 10.

Additional evidence on values specific to southwestern Montana is provided by Duffield et al. (1990). This study surveyed anglers and nonanglers on the Bitterroot and Big Hole Rivers in 1988. The purpose of the study was to identify the value of instream flows in these streams. Dichotomous choice CVM models were used to value current visits by recreators. The parameters are highly significant, and the Chi-square statistic indicates the logit model provides a good fit to the data. The original data set can be disaggregated to estimate separate values for anglers and nonanglers. Estimated net economic value per visit from these models is reported in Table 8B-4. Based on the most conservative measure of average value (the median), nonfishing trips on the Bitterroot are valued at $51, and nonfishing trips on the Big Hole are valued at $119. On a value per-day basis, these estimates translate into $35 per day on the Bitterroot and $65 per day on the Big Hole. The median value for the Bitterroot is within the range of the averages reported in the literature for typical nonfishing recreation uses in Tables 8B-1, 8B-2, and 8B-3. The Big Hole value is high compared to the literature average and may reflect the special quality of this river as well as the social and economic characteristics of the users, many of whom are nonresidents. Note that average values in Table 8B-4 are also reported for fishing visits; on both rivers the nonfishing values per visit are from 65 percent to 81 percent of the value of the fishing visits. This is consistent with the relationship found in the literature reported in Tables 8B-2 and 8B-3.

Table 8B-4
Comparison of Net Economic Value per Trip for Nonfishing and Fishing Subgroups Derived from Bivariate Models of Willingness to Pay ($ 1992)

River/Sample	Median	T-Mean* ($500)	T-Mean* ($1400)	T-Mean* ($2000)
Bitterroot River				
Nonfishing value $ per trip	$51.07	$132.67	$188.29	$208.67
Fishing value $ per trip	$77.79	$179.86	$282.43	$323.48
Nonfishing value as a % of fishing value per trip	66%	74%	67%	65%
Big Hole River				
Nonfishing value $ per trip	$118.80	$206.80	$302.09	$335.36
Fishing value $ per trip	$174.42	$255.25	$399.22	$451.99
Nonfishing value as a % of fishing value per trip	68%	81%	76%	74%

* T-mean is the truncated mean, a measure of central tendency computed by setting all values in the willingness to pay distribution above a given truncation level (for example, T = $500) equal to the truncation value.

Source: Derived from original data of Duffield et al., 1990.

The Big Hole and Bitterroot study (Duffield et al., 1990) was only undertaken during the summer months. The distribution of activities found in this study is reported in Table 8B-5 along with the distribution found by Hagmann (1979) for the Clark Fork River and tributaries. The Clark Fork has relatively more camping use in the summer. The Bitterroot and Clark Fork are similar in the distribution of fishing and nonfishing recreational use, while use on the Big Hole is dominated by fishing.

The general finding of this literature review is that average values for nonfishing recreation trips are in the range of $30 to $40 and that nonfishing recreation values (excluding hunting) tend to be from 60 percent to 80 percent of fishing values. Applying the most conservative ratio of 60 percent to the average value per additional fishing trip would result in a unit value for each additional nonfishing recreation trip of $27.39 (the implicit $45.66 per additional impacted fishing trip from Section 8.5 times 60 percent). These additional trips would be generated when the impacted sites are returned to baseline conditions.

Table 8B-5
Distribution of River Activities
Comparison of Hagmann, 1979 Clark Fork Estimates
and Duffield et al., 1990 Bitterroot and Big Hole Estimates

Activity Type	Hagmann		Duffield et al.	
	Clark Fork Summer Use %	Clark Fork Annual Use %	Bitterroot Summer Use %	Big Hole Summer Use %
(A) Nonangling Activities				
Floating	6.3%	5.9%	11.9%	40.8%
Camping	56.8%	50.5%	1.2%	19.7%
Hunting	0.5%	9.1%	—	—
General shoreline	36.3%	34.4%	86.9%	39.4%
(B) All Angling Activities vs. All Nonangling Activities				
Angling	45.4%	47.1%	40.5%	87.7%
Nonangling	54.6%	52.9%	59.5%	12.3%

Note: Percentages from Hagmann have been adjusted to reflect the exclusion of 950 summer and 262 winter "other" trips which could not be classified as either angler or nonangler.

Source: Hagmann, 1979, Table 26, page 64; and Duffield et al. original data base.

A value of $27.39 is selected as the per-visit value to be applied to all impacted nonfishing recreation trips. This value is near the average of the unit values reported in Tables 8B-1, 8B-2, and 8B-3 and is about half of the most directly applicable estimate of $51 for the Bitterroot River. In terms of the relative magnitude of nonfishing and fishing values, it is at the low end of the ratios found in the literature. In essence, this is a conservative interpretation of the values in the literature.

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